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NATURAL HISTORY

THE MUSEUM EXPLORING

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

EXPLORATION·RESEARCH·EDUCATION

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NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY, EXPLORATION, AND THE DEVELOPMENT OF PUBLIC EDUCATION THROUGH THE MUSEUM

THE MUSEUM EXPLORING

PLINY E. GODDARD, EDITOR

NOVEMBER-DECEMBER, 1926

[Published January, 1927]

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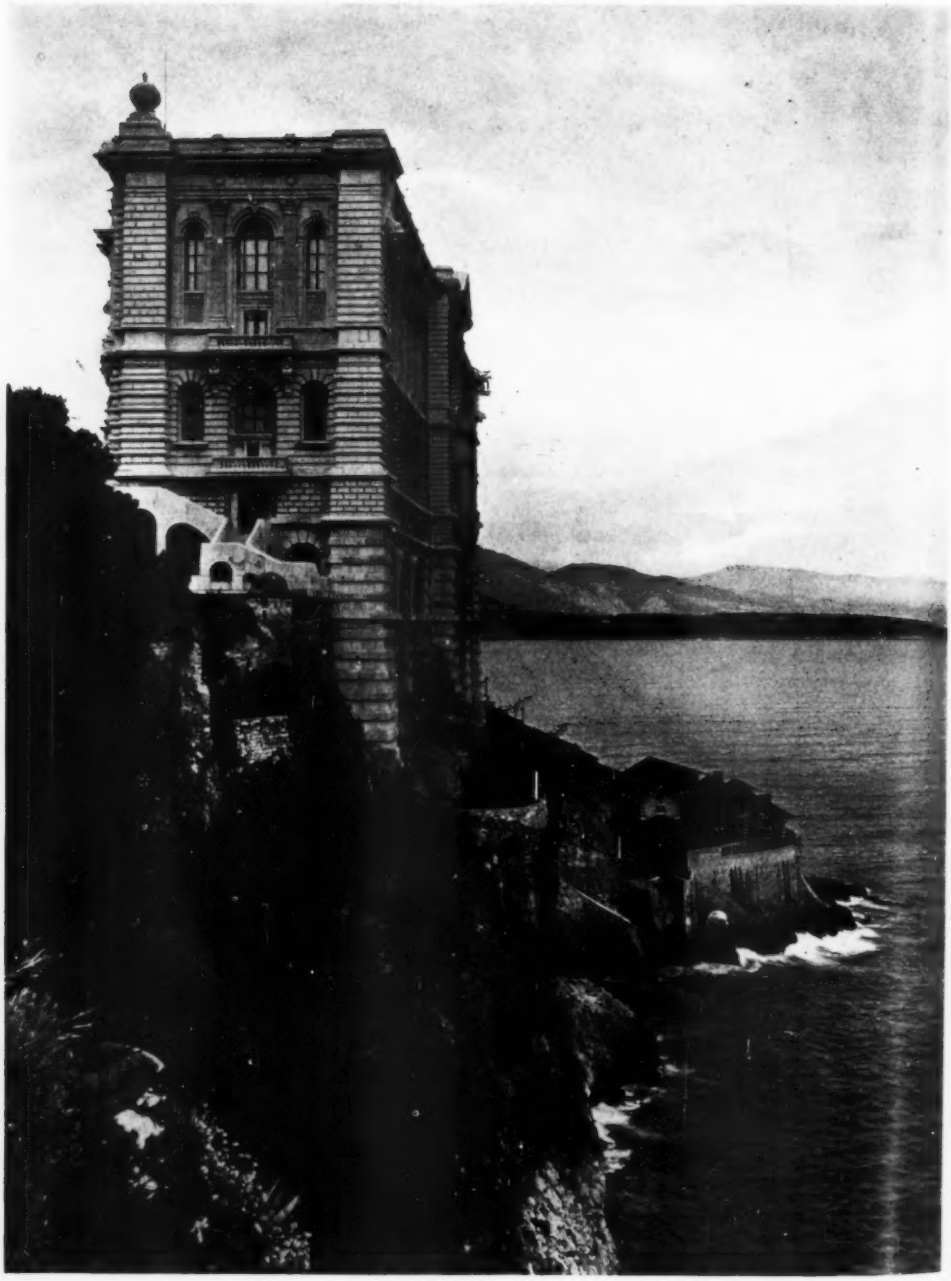
EXPLORING

IN order to provide habitat groups and other exhibits illustrating the natural history of the entire world, expeditions must be constantly in the field. These exploring parties travel over land to remote regions often difficult of access and lacking means for easy and rapid transportation. Other investigations require ships for the study of the life of the seas, islands, and shores more accessible by water than by land. There is also a vast and varied under-water world of both vegetable and animal life that must be explored and recorded by dredging and diving.

This issue of NATURAL HISTORY presents the experiences of several Museum expeditions during the current year. These include voyages in the Pacific, Atlantic, and Mediterranean, and up the great river of China, the Yangtze. While such trips often present the lure of the unknown and reward the participants with striking scenery and many pleasurable experiences, dangers are ever present. The Mediterranean is not always safe and comfortable for a small boat; and the Yangtze gorges, normally infested by bandits, were in the Chinese war zone. A hurricane devasted the very region in which Doctor Miner and his party were exploring. It is precisely this element of the unexpected and unknown, with the attendant dangers, that makes the explorer's life alluring.



THE OCEANOGRAPHIC MUSEUM AT MONACO

The only complete and most beautiful institution of its kind, this Museum was founded by the late ruler of the Principality, His Serene Highness Prince Albert I. It was dedicated in 1910. In addition to sumptuous exhibits illustrating oceanographic technique, fisheries and other marine resources, the physical and chemical properties of the earth's water, and the life of the sea in all parts and at all depths, the Museum also includes laboratories for oceanic research and an aquarium in which Mediterranean animals may be studied under conditions which simulate their natural habitats

NATURAL HISTORY
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A Cruise to Majorca

EXPERIENCES OF A SUMMER YACHTING TRIP, 1926

BY ROBERT CUSHMAN MURPHY
Assistant Director (Scientific Section)

THE windless sunset of July 13 lived up to Iberian traditions, making us forget for the time that such weather was getting us nowhere. The sea lay pale green, with purplish flashing hollows. No swell rocked our schooner; no air shook the sails. Over the red west the new moon carried a luminous sphere within her horns. The leaden east, toward Corsica, had a peculiarly impenetrable appearance until stars broke through, after which those of high magnitude cast unbroken beams across the water. At eleven o'clock our host, standing the evening watch, called me to the quarter-deck to see the whole bright reflection of the Milky Way in the depths of a refulgent mirror. Nothing of the sort came to mèmory from my previous life at sea and, moreover, for the first time I could discern stars down to the level of the eye, almost at the boundary of sky and water.

At dawn of the previous day we had left Monaco with a cool and lively wind which had been blowing for a week off the Maritime Alps. The Oceanographic Museum and the green promontory had gleamed in the first rays of the sun as we left them astern. All day we had slanted away from the Riviera on our westerly course, through increasing choppy swells from the north. Those on board who were not incapacitated by the sudden break from life ashore were on the lookout for sea birds, but it took an experienced eye to make out the fluttering specks which were stormy petrels, and which passed us bow and stern as they beat their way up wind toward the coast of France.

The "Wawaloam," the craft of our adventuring into old fields, had been placed at the disposal of the American Museum by her owner, Mr. Jesse Metcalf. She was a seemly three-masted schooner of comfortable Dutch build, equipped with every necessity and much more, including a laboratory under the forward deck. Best of all, she had for the time but one purpose, one objective—to be steered by the plan or the whim of a naturalist.

The favoring breeze of our first day at sea had carried us nearly half way from Monaco to Minorca, but the land wind vanished as the continent dropped below the horizon, and after noon of July 13 we were doomed to six days of calms and shifting cats-paws. It interested us to see how quickly and thoroughly the face of the Mediterranean accommodated itself to the breath of the native wind gods. From tumbling waves to flat calm, or *vice versa*, were transformations of but a few hours, and the aftermath of even a tempest brought nothing of the prolonged heaving of the open ocean.

With the flattening out of a rippled surface, the visibility of the tiny black petrels increased so that they could no longer be overlooked. Provided with a bucket of thin grease to make the necessary trail of bait, our host and I

often lowered the dinghy with the object of observing and collecting these ocean rangers. The birds turned out to be the true stormy petrel (*Hydrobates pelagicus*), the first described form of the whole cosmopolitan group of "Mother Carey's chickens," and which, since it belongs to waters on the Old World side of the Atlantic, has always been scantily represented in American natural history collections. Odd it seemed to find this bird not far from some unknown nesting ground in the sunny Mediterranean when we knew that its fellows of the same species were at the very time laying eggs at the far-away Faroes.

The "Wawaloam" at anchor in Alcudia Bay, Majorca

Such seeming anomalies, however, were largely resolved when we had gained a more intimate acquaintance with the waters in which we were cruising. Thermometers lowered into the sea at frequent intervals during both day and night showed surface temperatures of from 67° to 68° F., considerably lower figures than one might have guessed for midsummer. The associations of history and of human seasonal movements combine to make us link up mental images of the Riviera and Florida, the Mediterranean and the Gulf of Mexico, north Africa and the trans-Caribbean coasts. But the analogies are mainly false, for the Mediterranean is not a tropical sea. A huge continental lagoon of shallow or moderate depth, shut off from the Altantic by a submerged sill between the close Pillars of Hercules, it has acquired certain of the biological characteristics of equatorial waters, but its generally temperate relationships are indicated by the nature of most of the life which inhabits it.

Nevertheless, the low temperatures encountered during the early days of our journey are not to be taken as typical of the whole expanse. Alpine winds which had been whipping up the northern border for days on end had driven the littoral surface water southward, and its place had been taken by cooler water from below. The rising movement incidentally brought a more plentiful supply of the petrels' food within their reach, a circumstance which may help to account for the almost universal tendency of such birds to fly to windward.

This train of thought unfolded gradually while we watched the nimble *Hydrobates* from day to day, and added a number of them to the ornithological treasury of the American Museum. It prepared us to identify without surprise, and subsequently to collect, a still more boreal and somewhat larger species of Mother Carey's chicken, the one known as Leach's petrel, which nests on both sides of the Atlantic as

far north as Greenland. A specimen which showed by its internal condition that it was close to the height of its breeding season, fell into our hands on July 16, fifty-three nautical miles west-northwest of Minorca.

The reprehensible sport of shooting innocent little sea swallows was not without its thrills, despite the luxuriousness of our voyaging. One afternoon, for example, we set off on a bouncing sea during a lull in a fresh southeast wind. Pulling away in the squat dinghy, we laid our "slick" of evil-smelling bacon fat for a mile or more, and its prompt effect in spreading a smoother area about us was quite astonishing. Petrels, and a few of the bigger Mediterranean shearwaters, soon appeared from nowhere and began to work up from the leeward, respectively pattering and swooping back and forth across the oily streak, and clustering about the larger scraps of bait. But, in the meanwhile, the breeze had begun to blow with augmented force. The "Wawaloam," with her motor machinery spread all over its housing while the engineers tinkered with some defect, bore rapidly away two, three, four miles, before Commander Blair could bring her about. We felt that we were out of sight of the yacht, but were confident that the skipper had kept our bearing.

The wind was by this time a whole-sail breeze which quickly lashed up short and uncomfortable waves. A yacht's tender is at best a wharf-to-mooring, inside-the-breakwater craft, and no sea boat. Glad enough we were to hug the leeward margin of our own shimmering grease-patch, and glad that we had not yet used all our supply of galley fat to lure petrels to destruction. One of us at the oars held the bow of our diminutive tub to the wind, while the other spattered oil with utmost parsimony upon troubled waters. The Mother Carey's chickens whisked up lightly from astern, passed us sometimes at arm's length from the gunwale, and disappeared magically among the whitecaps ahead. They were immune from harm, and not only because we were thoroughly occupied; speaking for myself alone, I confess to a disingenuous, even though vague, propitiatory superstition. The birds' beady eyes carried no reproach, and perhaps, if we waved them cheerily by, the storm-controlling sprites would never suspect that several of their brothers' bodies lay rolled in cotton on the thwart.

The "Wawaloam" now bore toward us, with an ironical "come aboard" signal flying. We timed our strokes to back across her bow when she luffed, and were soon on deck, all dripping.

Now, when after a comparatively fair day's run, the schooner arrived one quiet morning fifty miles northwest of the nearest point in the Balearic Isles, we had an opportunity to observe something of the little understood vagaries of the sea and of the creatures which seek their own demarcated realms within it. During the night the surface temperature had risen from 68° to 75° F., a seemingly slight difference to the landsman who thinks in terms of atmosphere, but strikingly apparent when we plunged over for our daily calm-weather swim, and still more so when we observed what was going on about us. Perhaps we had entered a warm local current; perhaps we had merely passed beyond the zone of upwelling. At any rate, small flying fish, which had certainly not been in evidence in the cool water along the European coast, began to scud from our stem. Bonitos, leaping a man's height into the air, were in hot pursuit, and lines were quickly paid out to

Commander David Blair, captain of the "Wawaloam," and leader of the "St. George" Expedition to the tropical Pacific in 1924

tempt them. Dolphins or dorados, too, loafed below in the ultramarine shadow of the hull, their fins shining as sidelights of purple fire. Unlike the bonitos, they declined to be interested in either bait or spoon, and I recalled that the only time I had ever hooked and landed one of these wondrously opalescent fish was when running before half a gale in the South Atlantic. Sea insects — true oceanic bugs — jerked along the surface and, finally, the first shark, which may or may not have had any relation to the increase in temperature, swished past us with fins exposed.

The proximity of the Balearics was intimated, when we were still a day's sail from the land, by a sprinkling on the sea of small uniform particles which proved to be the seeds of the Aleppo pine. When the bare, wind-swept plateau of Minorca loomed on the horizon, butterflies, dragonflies, and smaller insects became common. Commander Blair declares that he saw a bonito catch a butterfly which was a foot or more above the sea. A whale or two spouted in the coastal waters, and lines of jumping porpoises, seen first at a distance, came to play under our bow when we were favored with wind enough to give us headway. In the afternoon, as we sailed past the low violet cliffs of Minorca, hundreds of the inimitable shearwaters were scaling and interweaving in a stiffening breeze off the land. We had no need at this season to seek the perfectly sheltered haven of Mahón, the Minorcan capital, for, as the Spanish sailors say,

> Junio, Julio, Agosto, y Puerto Mahón
> Los mejores puertos de Mediterráneo son.

Next morning the rugged headlands which flank Alcudia Bay, Majorca, lay on either beam. The folds of the escarpments made a jumble of desert brightness and heavy shadows, while

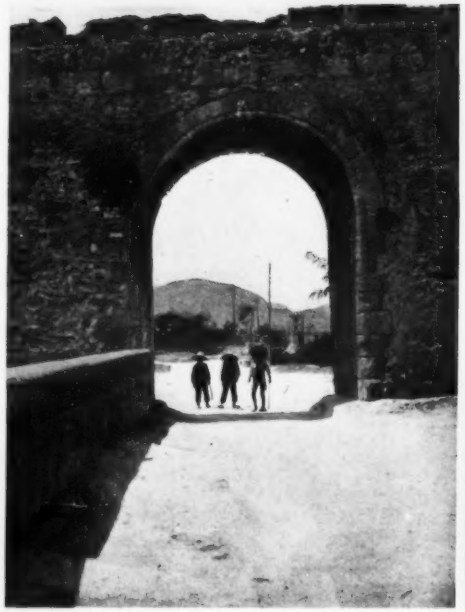
Recording the delicate and evanescent colors of the feet and webs of a Mediterranean shearwater

Pine-covered coastal hills of Majorca, at Alcudia Bay. The abundant Aleppo pine is responsible for the existence at the island of such northern types of birds as crossbills and kinglets

on the slopes below, copses of small trees seemed to be spread out with almost geometrical precision. Signs of human habitation were few as we scanned the vast landward horizon; the illusory spell which most islands cast over new-comers pervaded the still air of daybreak and the thin mist which clung to the face of the bay. It seemed as though we were entering a wilderness instead of a venerable and self-sufficient community with a population twice as dense as that of Spain.

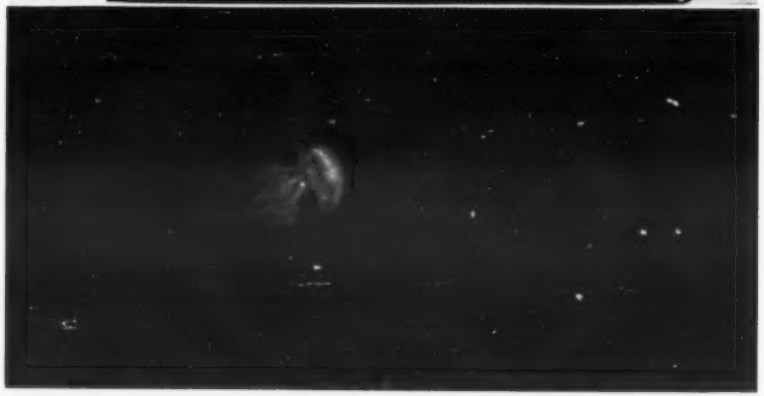
As the engine of the "Wawaloam" was still dismembered, the launch was lowered to tow us toward our anchorage, and we skimmed forward through films of pine seeds. A legion of huge pink and lavender jellyfish, trailing appendages which resembled clusters of translucent grapes, passed us on the outgoing tide, their mantles pulsating slowly. Thus we skirted a clearly discerned shelf under the margin of the bay, the swinging lead rhythmically plumping to the bottom, seven fathoms below, while we headed toward a tower of yellow masonry which appeared to mark the entrance to the hidden port of Alcudia. When we neared this lonely structure, which stood in a waste of shrubbery and stunted pines, a boat suddenly rounded the point beyond, and a pilot who might have stepped forth from a Zuloaga *genre* painting clambered aboard the "Wawaloam."

From our anchorage the moresque walls of Alcudia lay in full view, the boxlike church rising above all other buildings. The verdure of swamp land and of luxuriant thickets of pine and juniper at the head of the bay gave place first to the warmer hues of scrub-covered hills at the left of the town, and then in turn to paling stretches of scattered conifers and arid ridges toward the sea. When the first evening's sunset had faded to an afterglow, the piled up masses became steeped in the spectrum of Mediterranean magnificance, each successive crest endowed by varying distance with its own subtle and distinctive shade. But above the church of Alcudia, a hole through the farthest range made a window to the crimson sky.

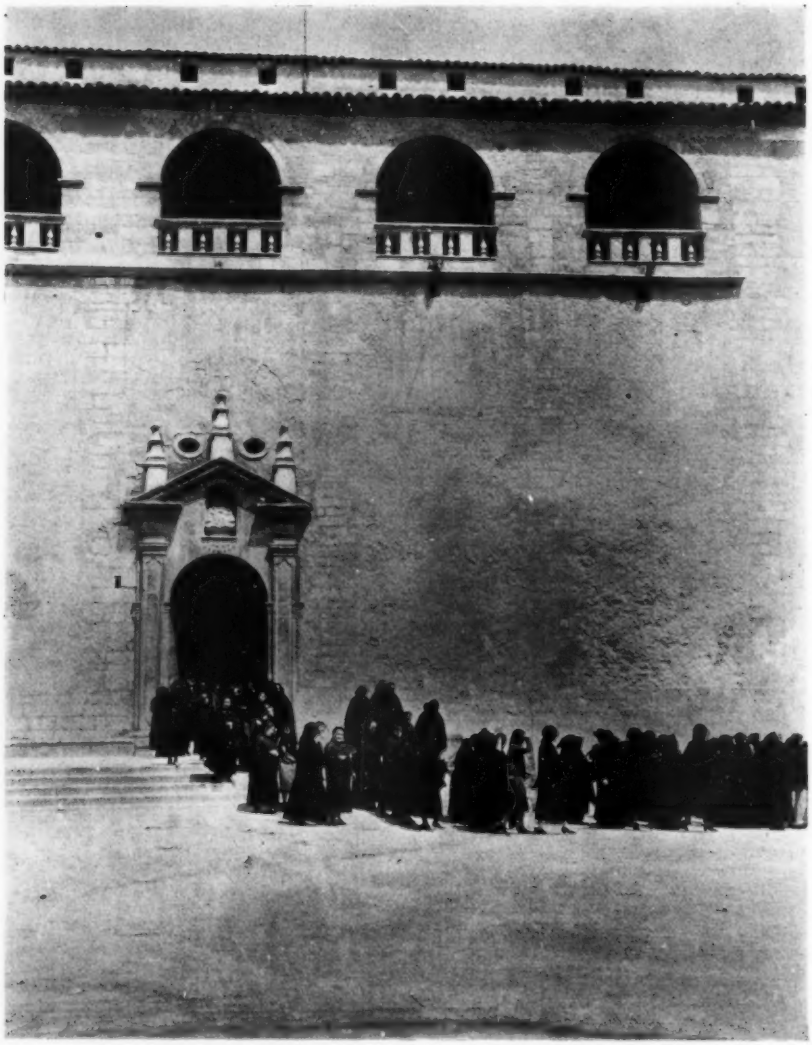


GLIMPSES OF ALCUDIA

At the left is the embattled watch tower of the port from which sentries of old cried the dreaded alarm "The Moors are coming!" In the center is one of the arched entrances to the town, with clusters of vegetation thriving in crannies of the crumbling stone. At the right are two tiers of massive walls and the double turrets of the Roman gateway which bridges the main thoroughfare leading through Alcudia toward Palma and other parts of Majorca



Left.—Señor Juan Jofre, pilot of Alcudia, who, between the rare calls of vessels, does a substantial business by shipping spiny lobsters to Barcelona. Upper right.—Fishermen of Alcudia Bay lunching in the shadow of their sail, with the "Wawaloam" in the background. Lower right.—A giant jellyfish passing the yacht's anchorage, the pebbly bottom, five fathoms below, showing indistinctly



Majorcan women filing out of the church at Inca after a funeral

At this hour, too, the fishermen set forth from port before the breath of the nightly land breeze. One by one their feluccas, with large and small lateen sails rigged yawl-fashion, glided silently past us wing-a-wing.

I am one of the contrary-minded travelers who prefer to read about a new region after, rather than before, visiting it. The stored facts of history and Baedeker doubtless prepare one to seize with most economy upon features which previous visitors have found entrancing; but, after all, the world is so full of charm that experience can hardly exhaust even the first choices. The appeal of the unknown, however simple; the joy of fresh impressions upon a blank page; the satisfaction of personal discovery—these more than compensate for an overlooked cathedral or saint's tomb. Majorca, queen of the ancient Aphrodisiades, lay before us. It mattered not, at the time,

that some say Hannibal was born here in the days of the renowned Balearic slingers, or that the ports of the isle were once the center of a medieval world bounded by the rich limits of Africa, Italy, France, and Spain. We gave no thought to the snug kingdom of Don Jaime, the Conqueror, to the great school of chart-makers which was here cradled in the fourteenth century, nor to the native mystic of the same period, Ramón Lull, whose strange philosophy is still studied by Majorcan youth if by nobody else on earth. For myself, I was yet ignorant that among the sublime hills, somewhere to westward of that beckoning hole-in-the-crest, lay the piny glade of Valldemosa where, in an abandoned Carthusian monastery, George Sand and Chopin lived in lonely contentment during the winter of 1838–39. But during the all too few days of our visit we were to find between Alcudia and the islet of Dragonera traces enough of the long past, with its succession of prehistoric, Carthaginian, Roman, Vandal, Saracen, and Catalan islanders.

With the "Wawaloam" at a comfortable mooring, we lost no time in setting about our field work. Our official host, the courteous captain of the port, explained that the issuance of credentials was here, as elsewhere, a time-consuming matter. He suggested that pending the arrival of documents from Palma we carry on our collecting under his personal ægis, confining our operations as far as possible to the coast. If, however, we wished to shoot in the interests of science among the hills, or in the marshes of Albufera, he offered to make the necessary arrangements with the owners.

So we began work in the launch, cruising along the base of precipices which extend from Alcudia Bay to the Bay of Pollensa. Here the twisted strata of limy shales have been cut back by the sea in steep or even overhanging cliffs, speckled in places with caves and niches from which rock doves streamed like bees from a hive as we chugged along below. Two or three hundred feet overhead, green pines leaned out from precarious footholds, and at that level an osprey and occasional Eleonora's falcons soared above the water. The latter species is a glorious little Mediterranean freebooter, related to our American pigeon hawk but with longer, sharper wings, shaped almost like those of a swift. A week later, at Dragonera, we saw as many as a score of them together, and became better acquainted with their marvelous aërial displays. On the updraft of the sea breeze, the falcons would glide along the brink of the Gibraltar-like cliff, and, suddenly half-folding their wings, they would hurtle toward the sea. Three, five, six, or seven hundred feet—a quick eye was needed to follow that breathless plunge down the vertical fault scarp. Sometimes it seemed as though the living darts would be swallowed among ripples which were in reality great billows breaking at the foot of the wall. But at the critical moment, the falcons would scale forward, to float again toward the heights and perhaps to repeat the dive. Clearly this performance was carried out with no other object than the joy of it. There was no food for the birds on the sea face of the islet. The full stomach of a specimen collected contained only remains of orthopterous insects, probably the grasshoppers which were abundant among the asphodel and warped bushes on the landward slope of Dragonera. Eleonora's falcons, however, have the reputation of being bird-eaters, and

their gift for dashing speed supports this. At this late season they were just beginning to nest upon the sea cliffs of the Balearics, which is possibly shrewd Nature's scheme for assuring a plentiful larder of northern songbirds, in autumn migration across the Mediterranean, at the very period when nestling falcons are most insatiable.

The rocky coast near Alcudia Bay was broken here and there by pleasant coves, unmarred by anything man-made, in which we could usually find flocks of shags and groups of Mediterranean yellow-legged gulls which closely resemble the herring gulls of the north. In the roofs of lofty, sea-level caverns small swifts[1] were evidently nesting, for the birds darted in and out with incredible rapidity more than gun-shot above the heaving water. Many lesser caverns were dark and deep; into some of them we could pole the launch until the light of day was nearly cut off behind. Such as these were, of course, the result of wave action, but higher up the sheer precipices were geologically ancient limestone caves of the type for which Majorca is famous. Upon one of the latter we stumbled when our eyes followed up an unaccountable flight of steps, hewn in the straight front of the cliff, to a half-concealed doorway sixty or seventy feet above. Inquiries among the fishermen brought out the universal Majorcan reference to the *tiempo antiguo*, and a hint about the never idle *contrabandistas* or smugglers. More than this we could not learn, but next morning we returned with blue flares from the "Wawaloam" and explored our find.

Landing at the foot of the steps was a ticklish matter, even in quiet weather. Once inside the half natural, half hewn gateway of the cave, we found our way blocked by a wrought iron door suspended between stalactitic columns. This, however, was not locked, and we went on to a devious passage which wound into the earth, sometimes opening into bristling chambers and again mounting or descending through tunnels by way of neatly chiseled stairs. It was clear that the original users of this sinister retreat had been actuated by no spirit of mere diversion, for an enormous amount of labor had been expended in quarrying, not to mention the forging and hanging of the prison-like gate. After perhaps four hundred feet of gingerly progress, we entered a vault as large as an ordinary church, which sparkled in the light of the torches as though it were lined with a million icicles. At the near end stood an overflowing basin of spring water, formed by a natural rim of limestone which had been built higher with masonry. At the far end, and along the dim sides of the chamber, were dark slides or *oubliettes* descending from the floor to nobody knows where.

Lack of flashlight apparatus was now a source of deep regret for the torches made sorry substitutes when we attempted photographs of the gleaming stalagmites and complete columns. We remained, however, until smoke

[1] In addition to *Hydrobates pelagicus* the following birds are referred to in the text. All were observed between July 16 and 30, 1926.

Leach's petrel (*Oceanodroma leucorhoa*), locality and date recorded; Mediterrean shearwater (*Puffinus kuhlii kuhlii*), off Minorca, Majorca, and Dragonera; rock dove (*Columba livia*), Majorca and Dragonera; osprey (*Pandion haliaëtus*), Majorca; Eleonora's falcon (*Falco eleonorae*), particularly abundant at Dragonera and observed also at Majorca and the Columbretes Islets; shag (*Phalacrocorax aristotelis desmarestii*), Majorca and Dragonera; yellow-legged gull (*Larus cachinnans*), Majorca, Dragonera, and the Columbretes; swifts in the sea caves of Majorca (probably *Micropus murinus illyricus*, but not collected). Other species worthy of note include Moroccoan shearwater (*Puffinus puffinus mauretanicus*), two off Dragonera, July 26; common sandpiper (*Actitis hypoleucos*), Columbretes Islets, July 29; red-legged partridge (*Alectoris rufa*), common on Dragonera.

The breeding birds of the Balearics are almost entirely European, rather than African, in character, but there are about twenty endemic races among the land birds. The resident avifauna numbers 102 forms, in addition to which nearly 150 migrant and visiting species have been recorded. (Cf. von Jordans, 1925, *Journal für Ornithologie*, LXXIII. pp. 194–207).

The needle of Dragonera, viewed from near the northeastern end of the bold islet. The lighthouse, which can be faintly discerned on the peak, has been abandoned because it was prevailingly hidden by clouds

Smugglers' cave in the sea cliff of Majorca, between Alcudia and Pollensa bays

One of the chambers of the cave, photographed with the aid of the yacht's signal flares

rendered the air intolerable. A final, and at the time inexplicable, phenomenon just before our exit provided a weird climax. Where the ash from our calcium lights had been falling through the murk to the warty surface of the limestone, it produced instantaneous jets of flame, which were accompanied by a crackling sound and followed by tiny but explosive puffs of smoke. The effect seemed to be cumulative, for presently an area about the bole of one huge pillar began to sputter like a battery of spark plugs. It is odd, in the cool light of retrospect, to think how such a normal and interesting chemical reaction could serve to precipitate our departure.

Our attention was not given entirely to the birds and caves. Majorca proved to be a moderately good fishing ground, especially important because the Mediterranean fishes, which have always been scarce in American collections, are the type forms upon which many of the early naturalists based their descriptions of wide-ranging species. We haunted beaches to which the fishermen, who carry on their trade week days and Sundays with the single exception of the Feast of All Saints, brought their catches. We informed our friend, the pilot, that we would purchase fishes of all sizes, large or small, without reference to their edibility. The fishermen, brigands only in appearance, were glad to humor our queer wishes; they asked no more than the market price and the privilege of watching us pickle the specimens in formalin. One crew even invited me to share their lunch, which they cooked in the felucca. I declined in a manner which seemed to content them by saying that I should prefer to record their meal with the motion picture camera. The most original incident was the passing round of the *parón*, a green glass bottle with a side spout like that of a watering pot, which was held six inches above the mouth while the wine streamed into thirsty gullets in a fashion altogether sanitary.

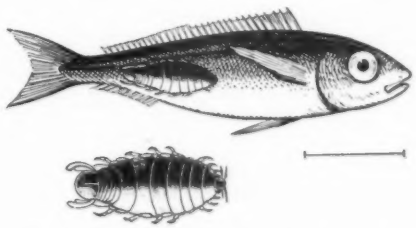
Sometimes we used an electric detonator to explode charges of dynamite under the water of gulches or caverns at the foot of beetling cliffs. The catches of fish were always extraordinarily small when compared with those obtained by the same method along the teeming west coast of South America or about remote oceanic islands. Although the Mediterranean has a wide variety of fishes and other marine organisms, it is a relatively depauperated sea as regards numbers of individuals. Our specimens included an assortment of sea basses (Serranidæ) and their relatives, porgies (Sparidæ), wrasses (Labridæ), and a scattering of others such as the sole, a scorpion-fish, a viper-fish (Trachinidæ), and the remarkable stargazer (Uranoscopidæ) which I had previously met in a porringer of *bouillabaisse* at Marseilles. The commonest single species everywhere on rocky bottom was the small black, blue, and gilded swallow-tail (*Chromis chromis*), a representative of a reef-living family known as the Pomocentridæ. The last, as well as the scorpion-fish and certain others, are tropical in their affinities, but the Mediterranean assemblage as a whole is distinctly temperate, though doubtless originally derived chiefly from warmer waters. It is a fish fauna comparable with that of the California coast, but quite unlike that of eastern North America where the boreal fishes come practically into contact with undifferentiated tropical forms.

One morning when a discharge of dynamite in five fathoms had brought slowly to the surface a handful of

fishes of four or five kinds, we observed that every individual of a small porgy (*Box boops*) had attached to its flank a proportionately large parasitic crustacean. This has since proved to be an isopod, identified by the name *Anilocra mediterranea*. The isopods live in the gills or upon the skin of fishes all over the world, but the extraordinary point about those which clung to the Majorcan porgies was that they were countershaded in an asymmetrical manner. The side of each crustacean which was toward the back of the fish was dark in color, while the other side matched the silvery belly of its host. Such a remarkable protective adjustment (if, indeed protection has anything to do with it) seemed a new biological variant. It was expressed so aptly that those isopods which continued to hold persistently to the right side of the dead fishes had their left halves darkened, while those on the left side of other fishes were oppositely shaded. Thus the usual type of countershading, which combines a dark back with a light ventral surface, and which favors the concealment of living creatures throughout many branches of the animal kingdom, was here altered to a right and left hand distribution of pigment, correlated with the peculiar position of the parasite on the body of its victim.

But we confined our travels by no means to trips along the wave-beaten coasts. In antique French motor cars, which could be hired at Alcudia, we crossed the great plain of the island and visited villages perched on hilltops. Fantastic place names dot the map of Majorca and draw one like a magnet. Where else, outside the vicinage of Cabell's "Poictesme," could one find such towns or localities as Aumelluitx, Estallenchs, Marroig, Lluch, or Andraitx? Perhaps the Saracen influence is to be sought in such unpronounceable words, for one of the last of the Moorish chiefs rejoiced in the name of Xuayp.

The agricultural country has all the picturesque charm of a semi-tropical terrane which has been tilled since the beginning of time. Protected by the sierra of the northwesterly coast, which attains an elevation of more



The parasite and its host. The lower figure show the actual size of the asymmetrically shaded isopod. The upper figure is drawn to scale, the line representing one inch

than five thousand feet, from the raw winds which sweep across the neighboring island of Minorca, the arable land begins first upon terraces which support wheat, flax, and the vine, and then descends by pleasant stages to the zone of palms and figs. True figs are the "figs of the Christian," while the lowly fruit of the cactus, introduced from America and now cultivated behind goat-proof *chevaux de frise* of prickly twigs, is known as the "figs of the Moor." Oranges thrive best in some of the deep valleys of the northern shore. Vast orchards of almonds give the plain in springtime the appearance of a garden in the Hesperides. In the bare, harrowed soil beneath the almonds, droves of native lop-eared pigs root and grow fat, while sheep graze upon grass allowed to flourish under the gnarled olives, all of which, if one were to believe the Majorcans, are "a thousand years old." Whatever their age, some of them are the most

MAJORCAN PASTORALS

(Left)—A heart-shaped hoe or mattock is used to spread the irrigation water which flows from a horse-turned wheel. (Right)—An orchard of ancient olives, and a typical small farmstead

THE COLUMBRETES ISLETS

(Left)—View of one end of Columbrete Grande from a gorge through the red and black volcanic ash of La Horadada. (Right)—Mr. Metcalf inspecting a sea cave of La Horadada. On the horizon is the volcanic stack known as El Bergantín

outlandish trees in the world, as almost every visitor has testified. They lured me into impressionistic flourishes in my notebook, but I have since found that the French artist, Gaston Vuillier, had already yielded to the same temptation, as follows:

> These trees . . . . , said to have been planted by the Moors, rear most fantastic figures. Enormous trunks end abruptly in plumes of branchlets. Others are twisted like gigantic cork-screws, or simulate dragons fighting coil to coil. Still others appear forbidding monsters with huge hands and the grimacing faces of trolls, hideous with wens and nameless excrescences. Some give the impression of running away in terror, their roots writhing with pain. . . . By moonlight I shivered, in spite of myself, before their gaunt forms vaguely discerned in the cool radiance. . . . The night breeze, rustling the leaves, sounded like spectral whispering, while preturnatural eyes glimmered from the trembling shadows.

Irrigation is used everywhere, and the Marjorcans of today are the heirs of an elaborate system of reservoirs, built by the Moors, in which the rainfall of winter is stored against the dry season. Aside from this supply the lowland is dotted with ceaseless water wheels turned by mules, asses, or even cows. All day long the blindfolded beasts walk weary circles, pausing in the palpable shade of an overhanging tree only when the voices of their equally toiling taskmasters are made faint by distance among the adjacent plantations. In some parts of the island the labor of animate creatures is replaced by that of windmills, often standing side by side in long rows, and doubtless of the same appearance as those which once goaded the Knight of la Mancha into disastrous combat.

The "Wawaloam" could not have put into a port of Majorca at a more opportune time of year, for the Feast of St. James, Patron of Spain, was celebrated during our stay. Throughout the week after our arrival, the streets of Alcudia were decorated with festoons and with green boughs carried down from the hills. Strings of electric bulbs lighted the plazas during the evening. The massive walls and gateways of the town which date, as the inhabitants with cheerful lack of agreement tell you, from the *tiempo Romano*, the *tiempo Moresco*, or simply *tiempo antiguo*, and which in any event had been quarried ages since from the great square pits outside the battlements, were likewise embellished with branches of the Aleppo pine.

On the happy day itself, Sunday July 25, we attended high mass at noon. The service had begun just before our coming, and we disposed ourselves without regard to the conventional segregation of men and women. However, the worshippers were uncritical of their guests, and the incomparable Majorcan courtesy went so far that the sacristan who took up contributions attempted to avoid us when he saw that we were strangers! A majority of the women were covered with mantillas, but a few modernistic young ladies wore hats. The choir was made up of boys more vociferous than musical, but the harmony of the organ left nothing to be desired. Of the sermon, preached in Majorcan, I understood not a word. It was a pleasure, nevertheless, to sit in the twilight of the ancient temple and to examine at leisure its attractive interior, which in taste of ornamentation and lack of tawdriness made a welcome contrast with many churches in more sophisticated Latin lands. The central chandelier, suspended from a hemp hawser which had evidently been spliced by sailors, was a

The bull ring of Alcudia.—The date of this picturesque structure was not learned, but it has the appearance of a Roman arena

splendid piece of wrought iron. Additional maritime touches could be seen among the votive offerings on either side of a subsidiary altar.

> Me tabula sacer
> votiva paries indicat uvida
> suspendisse potenti
> vestimenta maris deo.
> —Horace, I, v.

One of these was a pair of exquisite, brilliantly colored half-models of fleets of ships on a storm-tossed ocean, from the terrors of which some rare and perhaps unappreciated artisan of past centuries had been miraculously delivered. With my eyes wandering from such nobly fulfilled pledges to the simplicity of worm-eaten benches banked against the nave, my unreligious thoughts can be expressed in words by Edmund Gosse, who under somewhat similar circumstances confessed, "My instinct . . . , I am ashamed to say, is habitually confined to hankering after loot. I always discuss with myself what, in case of extremity, I should 'take away.'"

On the afternoon of this same Sunday, the festivities in honor of the sainted patron of Spain culminated in a bull fight. We came prepared to support the charitable ends which were to be served, but when we landed at the pier a written invitation from the physician of Alcudia claimed us all as his guests. As there were eight in our party, I slipped ahead to the bull ring with the object of purchasing tickets surreptitiously. But the doctor had circumvented any such move, and my good Spanish money was not acceptable. When our host overtook us, however, he very graciously relieved our minds by touching the surgical kit in his pocket and giving us to understand that, as the appointed sewer-up of any toreadors who might be gored, he had the privilege of inviting as many guests as he chose!

An Alcudian bull fight is a somewhat rustic affair which perpetuates a national custom, maintains a hospital, and produces a supply of cheap beef. No horses are involved in the affray. So far as the bulls are concerned, it is not much worse than other modes of slaughter, and if it has any unfavorable effect upon the Majorcan populace I can only say that this does not show in other aspects of the gentle island temperaments.

The ring scene on the feast day was

At the right, is part of the defensive wall of the town, and at the extreme left of the opposite half, the box of the *alcalde* or mayor

wonderfully exotic. The old stone amphitheater was crowded with enthusiastic men, women, and children. Carabineros, wearing *opera bouffe* leather hats, were standing with rifles at rest on either flank of the mayor's box. On one side, as we looked outward from the top tier, lay the blue bays of Alcudia and Pollensa, separated by a barren ridge, and on the other the tiled roofs of the compact little city, with Arcadian country-side and the soft azure mountains of the sierra beyond. The crowd had thrown off all its Hispanic reserve. Whenever a matador waved a charging bull beneath his caped arm, he was cheered to the echo, while derisive laughter greeted callow beginners scuttling to safety behind the barricades.

After the spectacle had ended we gathered at the physician's residence where champagne, anisette, and a table of pastry awaited us. The feast of the patron saint was also the doctor's name day; his intimates called him Don Jaime, and most of the cakes and bottles bore the cards of his friends. The band which had played at intervals during the bull fight now came before the house to serenade him, followed by a mob of other well-wishers. So all together we filled both the pátio and the street as we listened to music which had apparently been transcribed for the occasion, for small boys were holding manuscript sheets before the eyes of full-cheeked blowers of horns and clarionets. It was a living bas-relief from the Renaissance. The players were not professional musicians, but tradesmen, farmers, fishermen, shoemakers, and other guildsmen of Alcudia, who trained and puffed for the love of it, and who accepted no remuneration other than the approval of their townsfolk and the cakes and cordials of which the doctor now invited them to partake.

This was our last day at Alcudia, and sad enough we were to depart. After dark the "Wawaloam" nosed out of the bay into a heavy swell, and we set off toward our next stations which were to be Dragonera and then the Columbretes. At half past three in the morning I came on deck when Cape Formentor lay close abeam. The spectacular black promontory, looming six hundred feet above rumbling breakers, was topped by a tall lighthouse, and directly above beamed the round moon.

Prehistoric Man of Central China

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INTRODUCTION

THE caves and rockshelters of the Yangtze River Gorges were the special object of archæological investigation during the past winter season on the part of the Central Asiatic Expedition. With unexplored territory of continental dimensions before us, this particular choice of locality was nevertheless almost inevitable. Mr. Walter Granger, the Expedition palæontologist, had previously sojourned for two seasons in the country above the Gorges, collecting Pleistocene fossils; and in passing through the great chasms he had repeatedly observed and reported the presence of numerous natural shelters, obviously more or less suitable for human habitation. He also had caused minor trial excavations to be made in a few of the caves, and while nothing was actually found at these places, he did bring out two artifacts alleged by native workmen to have come from his own fossil pits. Little more in the way of encouragement could be asked for. There seemed to be held out to us here the half promise of—well, why not?—another Castillo cavern containing perhaps the whole story of the Old Man of Asia.

The Yangtze Gorges, it may be explained at the start, are one of the show places of China. Yet, like many other choice sights of the strange old Flowery Kingdom, this one, too, is hidden behind an unattractive exterior. A majestic waterway leads to it, it is true; for the Yangtze is the father of all Asiatic waters; but you have to traverse literally more than a thousand miles of low, flat, and generally unpicturesque country before you reach the impressive natural wonder. Once there, however, your interest is bound to awaken and, if reports are ever to be believed, it will not flag until you have passed on westward over the "roof of the world" to the very summits of the Himalayas. In other words, the famous Gorges are situated about 1200 miles up the Yangtze River, in the border region of the Hupeh and Szechuan provinces, approximately at the geographic center of China. The final point of departure for the scene is ordinarily the treaty port of Hankow, nearly 700 miles inland from the Pacific shore, and this starting point may be reached equally well by steamer from Shanghai and by train from Peking.

The Expedition, under escort of Mr. Granger, left Peking during the first week of November and by the fifteenth had reached the treaty port of Ichang, at the lower end of the Gorges. Some local reconnoitering took place here, sufficient at least to obtain actual traces (fragments of bone and pottery) of Neolithic man in a rockshelter directly across the river from the city. Preparatory to serious reconnaissance work, the Gorges were also traversed by one of the small steamers which ply the somewhat dangerous waters of the Upper Yangtze, with the result that considerable information of practical value was obtained, and a rough topographic chart was made giving the approximate number and location of the principal caverns. Documentary permits were secured from various civil

Going up the Yangtze.—Trackers pull the vessel up the rapids. At this one the line broke and the boat whirled around in the foaming eddies

and military officials under circumstances, I cannot refrain from emphasizing, at once strange and delightful, as well as surprisingly expeditious! Before the end of November, through the helpful assistance of the Rev. J. Herbert Squire of the China Inland Mission, a native vessel had been chartered and by December 3d we were off on our cruise.

Partly with the purpose of trying out our strange equipment, we at once dropped down the river some fifteen miles, to the lower limits of cliffs and visible caverns. At the small town of Kulowpei, therefore, we really began our slow, uninterrupted two and a half months' exploration tour up through the succession of great Gorges and beyond. It ended ultimately at Pai-shui-ch'i, a few miles above the port of Wan Hsien. Here the resumption of military activities practically compelled us to give up the river survey and we therefore retired inland to Mr. Granger's camp at Yen-ching-kou, about ten miles up a southern tributary valley. From these new headquarters, when weather permitted, joint excursions were made on foot in various directions, chiefly south and east, covering in particular the Hupeh-Szechuan border region. At the end of five weeks, or on March 24, we broke camp and all set out once more for Peking.

EQUIPMENT

Archæological exploration conducted from a boat was a new experience. Dictated by necessity and acceded to with some misgivings, we soon discovered its manifold advantages, particularly as regards mobility, comparative independence, and, we fancy, even personal security.

Our vessel—a *ma-yang*, in native parlance—was of 24-tons burden, 68 feet long and 11 feet broad, with a single mast of 55 feet. It had a low, toboggan-like prow, round bottom, bulging sides like our whaleback vessels

on the Great Lakes, arched roof aft and amidship, and a curiously high protruding stern, so constructed to accommodate the excessively broad and shallow rudder with its long tiller. Further to insure a straight course amid the dangerous swirls and eddies to be navigated, an extra-long, stout, oarlike rudder was also attached to the prow, from which it extended directly forward. In addition, two large sculling oars were fastened one on either side, and these, together with the 20 by 40 foot sail, completed the essentially permanent features of the really handsome craft.

Navigating the Upper Yangtze being at all times a tricky undertaking, it goes without saying that the mature professional sailor performs his tasks, especially at critical junctures, with admirable skill and precision. The vessels themselves—junks, sampans, etc.,—are no doubt the result also of age-long adaptation. They are built largely of whitewood, preserved with a coating of wood oil, and are therefore extremely light both in weight and in draught; and this unquestionably facilitates their easy handling. Propulsion in our case was effected in a variety of ways: by wind and sail when possible, by the sculling oars, and very often by mere poles and hooks. As a rule, however, in going upstream, the boat was simply towed at the end of a long bamboo rope by some six to ten members of the crew running along the river bank. The number of these trackers had to be increased to a hundred or more when we came to ascend the more difficult rapids. At the minor rapids, however, we helped ourselves, generally by the use of the capstan.

Such, in brief, were our unique and singularly adequate transportation facilities. With these went a perma-

Snow on the hills made the boys pull the mats over the boat early in order to keep warm

A Chinese stronghold.—This structure clings to a narrow ledge accessible only by a dangerously narrow trail

nent staff and crew of twenty-one people, all housed in more or less segregated quarters above deck. There was Mrs. Nelson, in the double capacity of purser and quartermaster, a native interpreter, a personal assistant for the reconnaissance work, a head boy, a cook, and, of course, the captain and his crew. Below deck was ample room for large quantities of fuel and provisions, as well as for tools, collected specimens, etc. The opium den, while not officially sanctioned, was there also. From the point of view of mere comfort and convenience we have never before enjoyed like field accommodations. The native members of our party very soon became adjusted to the limited quarters and the slightly new type of routine. In short, as a result of the adventure, it is safe to say that automobiling in Mongolia lost some of its former attractions for several of us and I for my part wished I could have sailed on westward straight to Constantinople.

INVESTIGATION

The work itself was in the main very simple. On its way through the Gorges, the Yangtze cuts across a great succession of more or less folded and repeated geological formations, including conglomerate, sandstone, limestone, shale, and granite. The most conspicuous of these is the limestone, which rises to heights of four and five thousand feet and constitutes the partially sheer walls of all the five or six distinguishable Gorges and their several tributaries. As would be expected, the limestone also provides

A good example of the type of cave occurring in the sandstones. The barren branches in the foreground belong to the renowned wood-oil tree

A cave in the Wushan Gorge.—Fine example of the caverns typical of the limestone sections of the Gorges

Avenue of grottoes.—Part of a long series of small caves such as are typical of the conglomerate formations near Ichang

Modern cave dwelling.—Partial view of a crescent-shaped cave near Wan Hsien, occupied by a Chinese farmer and his family, including goats, pigs, etc.

Neglected cave home.—View looking out of a large limestone cave at Yen-ching-kou village, Mr. Granger's headquarters during three seasons of fossil hunting

most of the real caves, which pit its surfaces from below the high water level almost to the summits of visible relief; but the sandstones, the conglomerates, and even the shales furnish a considerable number of generally modest shelters. Only the granites are entirely devoid of anything approaching the essentials of a natural habitation. Our chief task consisted in trying to see the entire environmental setting from the point of view of an imaginary primitive man; to guess which of the caves and shelters he would most likely have occupied since we couldn't visit all; to climb to those selected; and, finally, to test their floor deposits for chance inclusions of cultural or skeletal remains, as well as to examine the walls for possible pictorial inscriptions.

Hunting caves in this way was an exhilarating and even a fascinating form of activity, but it very soon grew a trifle discouraging. From the start nothing worth the name *prehistoric* turned up and before long it became tolerably clear that nothing much was to be expected. Nevertheless, the investigation went on as before, with reasonable thoroughness, in order to make the negative conclusions as certain as possible. In the end, after scanning more than two hundred miles of the Yangtze trough proper and traversing in more hasty fashiona similar distance in the back country to the south of the river, we were in possession of only the faintest suggestions that prehistoric man had ever been near the caves! This will seem all the more astonishing when it is stated, first, that a Late Stone Age man had left a fair sprinkling of his works both in the cultivated fields and on the river banks and, second, that a large proportion of the caves and shelters investigated proved to

be, or recently to have been, occupied by the Chinese.

This fact of modern occupation was at first regarded as a serious obstacle to the completeness of our survey. It turned out the opposite, for very often the occupied caves and shelters had been subjected to more or less excavating, done for a variety of purposes. Sometimes the clay floor deposit had been removed for use as soil to cover the small agricultural terraces built up of rocks on the adjacent slope; at other places it had been dug up and leached for its nitrous properties; and elsewhere it had obviously been cleared away for no other reason than to make room. The result was that whenever the earthen contents of a given cave were not all spread on the artificial terraces below, where it revealed its sterility at a glance, we commonly found within the cave a prepared section of the floor débris anywhere from one to twenty feet in thickness, awaiting our inspection. This meant a vast amount of time and labor saved for the Expedition, which in consequence was able to proceed with greater speed and yet with full assurance that no likely chance had been overlooked. In short, the Expedition is beholden in a variety of ways to the kindly and industrious cave dwellers of Szechuan.

DISCOVERIES

The extent of our exploration may be summed up briefly as follows: we navigated the Yangtze for a distance of a little more than 230 statute miles and made excursions on foot up various of the tributary valleys and into the back country totaling at least an equal distance. This, it will be understood, was in addition to the ordinary daily task of climbing about from cave to cave facing directly on the river. Of major landings, that is, such stops as involved actual examination of shore features, there were recorded, in all, 122; and the greater number of these were confined to the fifty-mile stretch comprising the Gorges proper. By way of accomplishment, we examined 367 caves and shelters, of which 139, or 38%, were, or had lately been, inhabited. Notice was taken also of the presence and position of 316 additional caves and shelters, many of which likewise gave proof of modern occupation. The results, so far as evidence of Palæolithic man was concerned, proved, contrary to lingering expectation, absolutely negative; and of Neolithic man we obtained in the caves only doubtful traces.

The investigation was not, however, confined entirely to the caves. At the very start of our cruise we discovered on the left bank, at the village of Kulowpei, what had been either a workshop or a settlement of Neolithic date. Most probably it was a village and quite likely the direct ancestor of Kulowpei itself. Coming upon the place at the low water season, we found, at the base of a thirty-foot bluff, a gently sloping foreshore, nearly 100 yards wide and 600 yards long, literally strewn with worked stone implements such as hammers, grinders, axes, chisels, hoes, and scrapers, and broken pottery. The prehistoric relics, unfortunately, were largely mixed with brickbats and débris of all kinds from the present settlement on the bluff above; so that while we were able easily to gather about 150 genuine old axes, we could not distinguish in all cases the ancient and the modern pottery.

This discovery became a clue as to what sort of archæological remains might reasonably be expected all the

Ancient Yangtze River village.—The Kulowpei roadstead, in the flatlands twenty miles below the Gorges. It was here on the bank directly beyond the boats that we found abundant traces of a Stone Age settlement

way up the river; and while it was pursued under protest and as a last resort, we at no time neglected it. The result was that we observed and collected remains of this culture at numerous points from the beginning to the end of our river cruise. Most of our finds, as already stated, were made on the surface, either along the river banks or above in the adjacent fields; but we did discover two undisturbed deposits of culture-bearing débris which gave us a partially correct idea of what traits belonged to the true Neolithic inventory. One of these accumulations filled a small rock cavity (too small for habitation), which we excavated and which proved stone tools and wheel-made pottery to have been, in part, contemporary. The other site was an open-air deposit exposed by a gully and revealing a thickness of nearly eighteen feet. Composed mainly of clay wash from the hills above, this section was nevertheless noticeably stratified, showing throughout streaks and lenses heavily charged with ashes and charcoal, fish and animal bones, traces of human bone, as well as considerable amounts of worked stone and broken pottery. Though the great mass of refuse seemingly implied a consider-

Collection of broken and unfinished axes, scrapers and hammerstones gathered within the space of a few square yards at the village of Kulowpei

able time duration, unfortunately, there were no appreciable changes from bottom to top in the character of the artifact materials such as might have been expected. This view is, however, subject to modification because, with a farm house standing on top of the site, we had to be satisfied with a merely superficial investigation.

CONCLUSIONS

These archæological finds, it must be emphasized, were all made on or very near the Yangtze River. Search in the back country to the south produced nothing decisive. It is true that we have the two artifacts brought out by Mr. Granger; likewise that in three places I picked up on the surface single fragments of foreign rock material bearing evidence apparently of human workmanship. But over against these doubtful and alleged discoveries may be cited the fruitless examination, first, of miles upon miles of cultivated fields and minor stream banks; second, of a respectable number of caves and rock-shelters; and, third, of the débris hoisted out of more than one hundred of the Pleistocene fossil pits. The indications all favor the view that Neolithic man, who certainly inhabited the Yangtze valley proper, was such a late comer that he did not have time to penetrate, at any rate, certain parts of the hinterland before he was overtaken by his metal-using successor, presumably the Chinese of early historic times. In other words, it would appear that the forest-clearing process begun with stone axes in late prehistoric times, perhaps three to four thousand years ago, is the process still being carried forward by the present agricultural population.

It would take too long here to explain adequately the scarcity of prehistoric remains in the Yangtze Gorge country. There are, however, plausible reasons enough, such as the comparative ruggedness and impenetrability of the country, the scarcity of game, and above all the nearly complete absence of flint and other rock substances especially suitable for the production of tools and weapons. Caverns, as such, were no special attraction to primitive hunters at any time or place except during extremes of cold,—and Szechuan is semi-tropical. Even Neolithic man in these parts preferred shelters of his own construction, and it is only in recent centuries, perhaps owing to the increasing scarcity of timber, that the Chinese farmers and fisherfolk have taken to the caves.

The results of this Central Asiatic Expedition survey of the Yangtze River Gorges, while in one sense disappointing, are nevertheless both interesting and illuminating. Being first reports on the locality, they are naturally of prime importance for archæological science. They show that prehistoric man played a very inconspicuous rôle in this territory, that he was not a cave dweller, not a hunter, but a woodsman and agriculturist, and that he arrived upon the scene, probably by boat, at a time not long prior to the introduction of the potter's wheel. They suggest, moreover, than Palæolithic man, the true hunter, either never reached the heart of China, or else that the forbidding character of the environment kept him out of this particular region. Of these two alternatives the second is of course the only safe one to embrace for the present; for not until the reconnaissance has been carried farther west, well up into the Tibetan highlands, can we safely exclude Palæolithic man from this corner of Central Asia.

A Houseboat on the Yangtze

By ETHELYN G. NELSON

WHERE but a few years ago ten thousand junks sailed the Yangtze, carrying freight and passengers over more than 1500 miles of waterway, today many steamers, large and small, are performing these offices, and the more picturesque native boats are rapidly disappearing from the river. So it was with some difficulty, and only after a search of two weeks, that we were able to secure one for a trip such as had been planned for the archæologist of the Central Asiatic Expedition during the winter of 1925–26. At last, just as we were beginning to despair, we came suddenly upon the very boat for our purpose and, after the inevitable amount of bargaining, found ourselves in possession of a floating home. It was not really a houseboat, merely a freight boat which had recently discharged a cargo from up river and whose captain was looking around for another to take back.

Our vessel was not large and the personnel, including the captain and crew and the five members of our personal staff, numbered twenty-two. Nevertheless, when we were all settled down in our respective billets we were scarcely more crowded than in a small New York apartment, and we had a lot more fun. True, we had to learn not to bump our heads on the ceiling beams of our special compartment, but a few hard knocks taught us to be cautious. Mr. Nelson and I occupied the center of the boat, with our servants and the captain at the stern and the crew out in front; and although there was no outside passage we were not troubled by any use of our quarters. When it was necessary to pass from one end of the junk to the other the boys simply ran over our roof. Their own sections had no permanent roof, being covered with large mats which were only drawn over at night or when the weather was bad.

On the Yangtze the men who tow such boats as ours are called "trackers." The path they follow is sometimes down near the water's edge, at other times so high up on the face of a cliff as to appear from below like a mere pencil mark. Often among the bowlders it is so indistinct as to be almost invisible and again it is a real highway paved with stone. Our trackers were mostly mere boys or very young men. They were dressed in the scantiest of cotton clothing in spite of the winter season, and in some cases this was so covered with patches that the original garment had well-nigh been lost sight of. Some wore straw sandals, others were barefoot. Such insignificant details, however, had little power to quell the abundant good spirits of these boys. When the boat tied up they usually began skylarking on the beach, regardless of the fact that they had been running for miles, often plunging into the icy water stark naked to free the rope from troublesome rocks. They were equally prompt to retrieve a duck which had been shot on the water or to dive for a lost article. We grew very fond of them, as well as of our genial captain, whose soft persuasive voice would have coaxed renewed efforts out of the most stubborn of boatmen—or extra dollars from the pocket of the reluctant foreigner. Only once did we see him lose his temper, when he applied terrific epithets, which fortunately we did not understand, to the first mate, during a

The "Fairy Bridge," scene of our first anchorage

serious struggle to pull the boat over a difficult rapid. The mate himself jumped up and down in his wrath and displayed all the symptoms of an apoplectic fit. However, neither seemed to cherish any grudge after the incident was over.

But my special pet on this expedition was Hsi-tze, the cabin boy—a chubby, rosy-faced youngster of about nine years, who was certainly the most important member of the crew next to the captain. From morning until night his name was being called from one end of the boat to the other and was always responded to with a cheery "Hi!" as he scrambled over the roof, mop in hand, or rushed to get the captain's pipe and fill it, taking a few puffs to see that it was well lighted before handing it over. At times he even went on shore and took a turn at pulling on the rope, while at hoisting the sail or handling an oar, he was as lusty as any, joining in the vigorous chantey and stamping his feet with the best of them.

Our cruise started where the flat country which borders the Yangtze

River all the way from Shanghai rises into hills a few miles below the city of Ichang and the really picturesque region begins. The first night's anchorage was most appropriately at the Fairy Bridge—a natural arch spanning, as it were, the gap between the monotony of the plains and the splendor of the Gorges. Of course we did not proceed at night, even the steamers do not do that in this part of the river, and the charm of our mode of travel resided largely in the fact that we stopped wherever fancy or business demanded. A wave of the hand to the captain and in less than five minutes we were running over the gang-plank and beginning a scramble up the hillside toward a cave or a temple, while the crew scattered along the river bank and sought for any of those curious rocks of which they soon learned that the archæologist was particularly fond.

They learned this, I may say, almost at the outset of our trip. We had stopped to buy some supplies at a village. Mr. Nelson never missed an opportunity to look the ground over, so even though the prospect did not look very favorable, we strolled along the shore to examine the bowlders with which it was strewn. Soon we were excitedly picking up the fragments of stone axes scattered every where, later to discard these and replace them with the better specimens which a longer search revealed. Children of the village joined in the hunt, bringing to us at first any sort of rock, but shortly learning to discriminate, and in the end so surrounding us that we had no chance to do anything and were obliged to take refuge in the boat. We never found another place so rich in specimens as that, but it served as an excellent object lesson for our boys, who seemed to enjoy hunting thereafter and were greatly delighted when a piece of their finding was pronounced *ding hao* (very good) by the master.

Christmas Day found us at Ichang, a thousand miles from the mouth of the river and only a few miles below the entrance to the famous Yangtze Gorges. We were so fortunate as to receive an invitation from Mr. and Mrs. Squire of the China Inland Mission to join them at an excellent Christmas dinner, just another of their many kindnesses which did much to make our river trip comfortable and happy. And I should like to remark right here that if it were not for the missionaries in China the way of the foreigner would be very much rougher than it is at present. They extended many courtesies to us at various points on our journey.

Ichang, viewed from a distant hill or from the river, presents a very attractive appearance. Its white houses with gray tiled roofs follow the curving line of the beach and face a series of pyramidal peaks on the opposite shore. But to walk its narrow, dirty streets, besieged by awful-looking beggars, possibly passing the body of some poor person who has given up the struggle and is callously left lying where he fell —these things make one want to run far away to some cleaner country where people have sensibilities and hearts. The river was very low at that time, and the foreshore was covered with the temporary mat houses which the natives occupy until the rising of the water in the springtime compels them to retreat cityward again. Many sampans lay along the water's edge to carry passengers out to the steamers at anchor in deeper channels, and the harsh cries of their owners soliciting trade made the night hideous. So we were glad when we were able to move on up river.

Snow lay on the hills for a day or two and we had to light our brazier in the evening to keep our feet warm. Usually we found our little cabin very comfortable with only the heat of the lantern by which we read. Our boys kept the sheet-iron kitchen stove stuffed full of wood from morning until night and as this was very near it served to warm us also. These boys we had brought from Peking—they were in fact a part of the regular Expedition staff of servants for Mongolia so they knew our requirements and looked after our needs punctiliously. Sha cooked our meals well and Wang served them with as great care as if we were in our own home, deploring the ragged tablecloth, a relic of Mongolia, but insisting on giving us finger bowls. We took along a sufficient stock of canned goods and in addition it was possible to buy chickens, eggs, and vegetables at almost every village. Little meat except pork could be obtained, this being the principal form of flesh eaten by the Chinaman when he is able to vary his chiefly vegetable diet. Oranges and pumalos were also plentiful along the river.

There had been much talk of bandits before we started, and of soldiers who would not hesitate to take a shot at us if they felt in the mood. On several occasions we were warned by the captain to have our guns ready, some of the villagers having reported bad men in the vicinity. Mr. Nelson thereupon laid his pistol within reach when we went to bed, but I do not think that either of us was sufficiently impressed by the danger to occasion loss of sleep, except that caused by the excited conversation of the boatmen, who apparently sat up most of the night looking for trouble. We were never at any time molested, though we were necessarily obliged to carry with us a considerable sum of money to keep our outfit running. It is only fair to say that we were under the protection of what we called our "river god," an inscribed tablet which stood on a shelf in front of the captain's small

This beautiful colored temple lies opposite the town of Yun-yang-hsien

Every farm has its shrine before which incense is burned to insure success for the crops

Caves, with their mysterious nooks and crannies suitable for installing images of the gods, are favorite places for Buddhist temples

We spent more than a week in the twenty-four mile Wushan Gorge, the longest and finest of the Yangtze Gorges

Sunset on the Yangtze transforms the river from a yellow turgid stream into a glistening bronze mirror

cabin behind our kitchen and before which incense was burned on occasion —presumably when we were in danger of a bandit raid or about to cross a difficult rapid.

Travelers in junks do not look with great favor upon the steamers which are continually passing, and we were no exception to the rule. They raise enormous waves as they plough along and toss the small boats around unmercifully. Sometimes as many as six passed us in half a day. If our little vessel was lying by the bank, the boatmen had to exert every effort to keep it from being smashed against the rocks. So when we saw a steamer struggling to make a difficult rapid we did not feel toward her the brotherly sympathy which the situation seemed to demand. On the contrary we chuckled as she snorted fire from her smokestack and made awful noises with her engines. Once we had the satisfaction of being able to lend some of our own trackers to assist a steamer over a bad place. We did not, however, let our vindictiveness carry us to the point of being glad when one of these larger vessels was actually wrecked, as occurred several times during our short sojourn on the river, once just the day before we reached the scene.

Proceeding through the Gorges slowly as we did, we lost none of their grandeur or beauty. Long vistas opened up before us which we could enjoy to the full before we had compassed their length. Anchored at the base of some towering cliff, our small boat shrank into insignificance, and we could only restore self-confidence by climbing high up the steep walls to increase our perspective. The season was too late for the semi-tropical foliage to be at its best, but there was still the delicate loveliness of the bamboo groves, while clusters of graceful palms shaded the small wayside shrines or marked an ancient tomb. Occasional bushes of brilliant red enlivened the dull gray or brown of the rocks, and wherever the farmer could get a foothold on the slopes, or find a bit of soil in which to drop seed, patches of vivid green testified to his industry. Sometimes a cave high upon the hillside had a stream of water flowing from it which cascaded over mossy stones to join the river. Black and white limestone ridges rose in fantastic peaks and spires and afar off on some pinnacle the gleaming walls of a temple standing against the sky seemed to tempt the first high wind to blow it from its perch.

Everyday was washday along the river, but at Wan Hsien the women were particularly active

This steamer came to grief in trying to avoid running down a junk the day before we reached the spot

These temples, which occur at frequent intervals along the river, serve other purposes than merely to ornament the landscape. Their chief end is to keep the river dragons from wrecking the boats, and if you pay tribute in passing, your safety is assured. One day we climbed a very long and steep stairway of many, many stone steps to reach a small cave in the vicinity of a temple. Contrary to the usual experience, no one seemed to be around collecting coppers to placate the gods, and we got back to the boat with our funds intact. Some time in the middle of the night we were roused by shouts from the bank, followed by a few sharp words in the voice of our interpreter. In the morning we learned that the "priests" had heard of our visit and had come down to exact a fee for enlisting the aid of the gods on our behalf, but as our boys refused to disturb us they withdrew, muttering ominously, "Well, we have warned you." That we suffered no inconvenience from this can only be attributed to the fact that our own gods were more powerful than theirs.

Other guardians of the temples were more vigilant. One man had a unique device for collecting money, consisting of something like a butterfly net attached to the end of a long bamboo pole. He stood on the rocks by the side of the river and as soon as a boat came within reach he thrust this receptacle over the side for a contribution. Later we climbed up to his temple, quite an imposing one situated in a large cave and furnished with many Buddhas, and he regaled us with tea and sweetmeats. Adjoining the main body of this temple, a large image of the Buddha carved from the living rock has a lamp continually burning before it and is quite black from the oil which has been poured over its head by many generations of worshippers.

On our long walks over the hills and through the side valleys we encountered a good many of the country people, who looked upon us as curiosities though they were always good-natured and ready to exchange ideas on the slightest encouragement. Our means of communication was chiefly the sign language, but it is astonishing how much one can put over in this way when he has to. If they sometimes got the idea that Mr. Nelson's stone implements which he tried so hard to explain to them were merely his special brand of "medicine," no harm was done and we parted friends. The women were

especially interested in the things I wore, almost undressing me in their eagerness to see how my costume was built up, and taking off my hat to look at my hair. It is possible, that on account of my feet they may have doubted my being a woman, since they themselves were hobbling about on little stumps, even those who were carrying heavy burdens or working in the fields. At times we were invited into their homes. On one occasion we were treated to hot popcorn and our pockets filled with sweet potatoes. At another time it was the home of a fisherman and his wife, who lived in a cave. This man said that his family had occupied that same cave for more than a hundred years. The furnishings were of the simplest type imaginable. On a raised portion of the rock floor at the back, mats were spread for a bed. The front part of the cave contained a table, a couple of benches, and a stove built of clay on which was a large shallow iron bowl for cooking the rice and vegetables which constitute their chief diet. Some chinaware bowls and the indispensable teapot completed the equipment, which doubtless had been the same for the entire time of occupation.

We did not care so much for the people of the villages. They were more sophisticated and the small boys insisted on following us in droves and hampering our work of examining the river banks for specimens. They had fierce dogs, too, which had a disconcerting way of rushing out at us as if they would tear us to pieces, and sometimes they seemed to mean it. There was little difference in the character of these small villages and a visit to one or two was enough to satisfy our curiosity. Narrow, and to our senses at least, very dirty streets, were bordered by tiny dark shops where meats, vegetables, live ducks and chickens, articles of clothing, and numerous other things were mostly displayed on a front counter or sometimes actually out on the sidewalk for the pedestrian to make his way around as best he might. Mangy and hungry dogs and pigs wandered about seeking stray bits of food. Repulsive beggars blocked the way holding out bowls for coppers and whining dolefully. Open cesspools offended both sight and nostrils. Apparently the natives enjoy these conditions, as they huddle together even where there seems plenty of room for expansion of their quarters. So we did not linger in the villages any longer than was necessary, but hurried away to breathe the flower-scented air of the fields.

The Feng Hsiang Hsia, or Wind Box Gorge, is the last to be traversed on the trip up river. While the shortest, it is perhaps one of the most impressive, the cliffs being very high and of many picturesque shapes. Things of interest pointed out to every traveler are some coffins lodged in a cleft of the rock in what is now an inaccessible spot; the iron rods where a chain was once drawn across the river by a general in charge of of Kuei-fu to prevent his enemy from ascending and attacking that city; and the holes in the cliff which the wily enemy had made to hold the pegs on which his men climbed around and thus reached the city after all. At Kuei-fu itself are the salt springs which are worked feverishly all winter when the river is low. In summer they are buried under the yellow waters of the Yangtze. The white steam rising from the evaporating pans gives the appearance of an active volcano from a distance, while a visit to the scene shows naked workmen silhouetted

against a background of glowing furnaces as they stream in and out of the brine pit carrying water to the pans.

While lacking the grandeur of the Gorge region, the country between Kuei-fu and the village of Pai-shui-ch'i, a few miles beyond Wan Hsien, where we dismissed our boat and became landlubbers again, was by no means without interest. We found a good many caves and visited various temples. The farms presented a more prosperous aspect as we neared Wan Hsien, with beautiful green fields and glistening rice paddies. Water seemed flowing everywhere. Even the air was full of vapor so that the landscape appeared as if seen through a veil of gauze. Sugar cane was being harvested and once we passed a mill where three water buffaloes were employed in crushing the stalks with a big roller. The harvesters offered us pieces of the cane, which we chewed and found quite refreshing.

The captain had been very proud to sail his boat under the American flag. When we gave it into his hands at Ichang he immediately had it hoisted about halfway up the mast. We objected to this as giving our craft the appearance of mourning, so he hung it on a pole at the stern. We would have taken it in at times to save it from being whipped to pieces by the wind, but we hadn't the heart to insist on this in the face of his evident reluctance to take it down. In the end it would appear that his attitude was justified. No sooner had we said goodby to the outfit, which we did with considerable regret after all these weeks of happy roving, taking our flag with us, than soldiers descended upon the boat and took away most of the crew to serve as baggage coolies, besides robbing the captain of twenty dollars and several bags of rice. We were sorry, but we were helpless. Our voyage was finished.

Pagodas are placed on promontories for the protection of the river craft

The water front at Nassau. Photograph by F. L. Jaques

The Bahamas in Sunshine and Storm

By ROY WALDO MINER
Curator of Lower Invertebrates

NOTE.—The work of the expedition described in this article was carried on in two localities in the Bahamas, and had two main objects. In connection with the first, at Nassau, capital of the Bahamas, Doctor Miner and his wife, Eunice Thomas Miner, secured photographs and motion pictures illustrating the life and industries of that picturesque city. This portion of the expedition was financed by the general funds of the Museum. The second, at Andros Island, was made possible through the generosity of Mr. John S. Phipps and his son Mr. John H. Phipps, the latter of whom shared the leadership of this part of the expedition with Doctor Miner. In this case the expedition continued Doctor Miner's study of the Andros coral reef, in connection with the new coral group for the Hall of Ocean Life. During their stay here the party experienced a hurricane. On their way back to New York, Doctor and Mrs. Miner made a second trip to Nassau and obtained photographs of the destruction left in its wake. The story of the trip naturally falls into three parts.

TROPICAL NASSAU

IT was a beautiful morning in the latter part of June. The good ship "Munamar" was gently swaying at anchor in the roadstead outside the harbor entrance, where for the last three years a huge steam dredge had been steadily at work deepening the channel. In the course of time, as it is counted in Nassau, the liners from New York will enter like vessels of lighter draft and dock at the city wharf. Just now, however, we had to curb our impatience until the puffing steam tug came blustering out with two huge lighters lashed to her flanks, to take passengers and cargo ashore.

Our three days' voyage from New York had been delightful, with the charm that always attends slipping from the dull green waters of the North to the brilliant deep blue of the tropical sea and sky. Though it was the month of June and, as we reckon it, summer, the heat of the tropical sun was not so oppressive as in New York at this season, and as we lay off the portal of this island of perpetual June, with the trade winds, laden with the spicy fragrance of tropical blooms, blowing over

its gently sloping hills, the thought was borne in upon us, that here summer resides as in its natural home, and is not the fitful series of scorching blasts which, in northern cities, drive us restlessly to shore and mountains in search of comfort.

Baggage and passengers were now transferred to the tug, and from the upper deck of this self-important craft we watched the panorama of beautiful Nassau unfold itself as we swept in past the lighthouse guarding the harbor entrance. The rose-pink walls of the great Colonial Hotel showed conspicuously amid groves of waving palms. Away to the eastward, like a kaleidoscopic ribbon, stretched the low hills, dotted with picturesque houses of yellow, and pink, and blue. These peeped forth amid luxuriant groves of coconuts, royal palms, and casuarinas, their garden walls brilliant with flowering vines.

The landing place was almost hidden by the masts and sails of the sponging fleet, idle at this time of the year. Finally our craft nosed her way to an unoccupied berth, and soon we found ourselves ashore and attending to our baggage beneath the lattice-covered customs shed. The friend whose hospitality we were to enjoy, though an American, believed that motor cars and Nassau were not consistent. There were plenty of these dashing about. In fact, a native proudly told us there were "seven hundred cahs in Nassau, yaas suh." But the narrow streets of this quaint and ancient city, with high garden walls masking the corners, certainly are not adapted to the chariots of modern civilization, for one never knows what sort of an accident awaits him around the next corner. Previous visits had taught this, so it was with a feeling of distinct relief that we heard our host state that, during his frequent stays in Nassau, it was his custom to engage the entire services of Nathaniel Cambridge and his "sea-going hack." These traditional vehicles are two-seated, canopy-topped affairs, often in a state of semi-decrepitude, and drawn by a diminutive and equally frail "hoss." Mr. Cambridge, however, is a gentleman of enterprise as intense as his complexion, for his equipage was neat and shining, while sturdy little Lion, tossed the spirited tawny mane which gave him his name, and showed himself to be as well conditioned and ambitious a horse as one could wish.

Seated in this conveyance, we jogged out through Rawson Square and down Bay Street, the business center of Nassau. Before a cluster of public buildings of graceful colonial type, a marble Queen Victoria is seated on her

Panorama of Nassau from the hill-top. The Colonial Hotel rises in the middle distance, with the harbor beyond, separated from the open ocean by low-lying Hog Island. Photographed by Sands

Nathaniel Cambridge and his sea-going hack ready to start on a photographic expedition

Entrance gate of old Fort Montagu, captured by the Americans during the Revolution

throne. To the left an enormous silk-cotton tree, ancient in years, raises its shaggy head. The picturesque shops of a past generation are interspersed with more modern structures, bespeaking a recent prosperity not wholly disconnected with the prohibition movement in the United States. So does national reform contribute to the well-being of communities not within our borders! In the shade of a spreading tree, rustling with the dried pods of "old women's tongues," a well-appointed and modern granite bank building welcomed our American travelers' checks and transmuted them into English pounds. The genial manager, the Hon. G. H. Gamblin, who is also the presiding officer of the governor's council, at once fell in with our desire to photograph, so far as possible, the life and industries of Nassau for the American Museum, during the two weeks at our disposal. Through the efforts of this official, these plans were greatly expedited. We continued on our way, turning up picturesque George Street and around the grounds of Government House, whence we passed westward between garden walls overhung with cascading tropical vines aflame with the magenta blooms of *Bougainvillea*, or golden with the drooping blossoms of the yellow bell-flower. Halfway down the hill a *Poinciana* spread its huge clusters of scarlet almost across the entire street, while the slender, silver shaft of a royal palm, rising from its midst, pierced the brilliant blue of the tropic sky with its plumed crown of foliage.

A sponge yard. Native women filling baskets for the clippers

The picturesque antiquity of Bay Street is invaded by the modern motor car

Outside the market on Bay Street. The tree was stripped by a recent hurricane

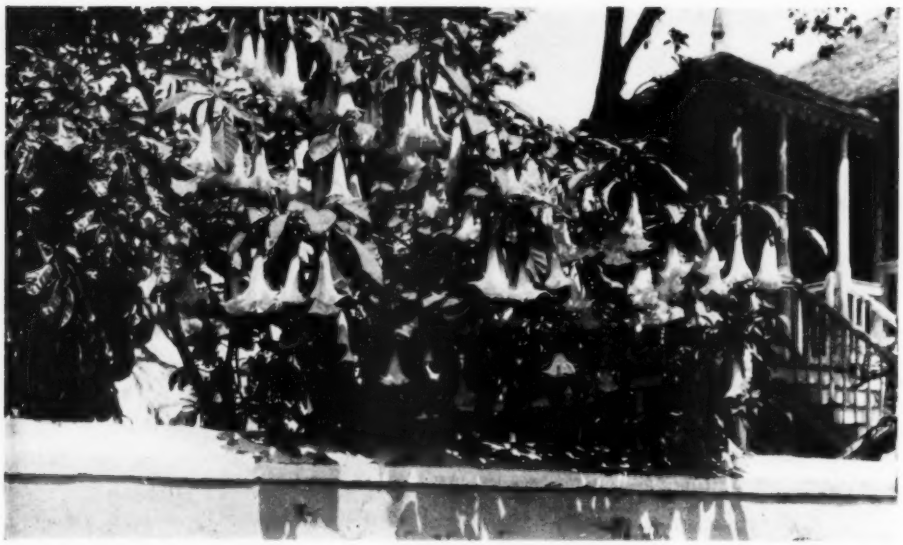
The outer market on the wharf, with fruits and vegetables in great variety

Finally we turned up a street on the crest of the hill, drove through a gate, and along a driveway to the front door of a mansion, where our host stood ready to greet us. Here we were made comfortably at home in a part of the house from which we could look south and east over the rolling hills of New Providence, with their waving coconut palms and casuarinas, and north over the vivid blue of the Atlantic, where the ship which we had just left lay at anchor. Not far to the west the tall skeleton masts of the wireless towers dominated the sky-line; while at our very feet, the houses and walled gardens of the city rose tier on tier from under the wings of the hotel.

During the next two weeks Nathaniel Cambridge and Lion were our constant companions. The "sea-going hack" bore us with our cameras and moving-picture machine through the highways and lanes of Nassau and the surrounding country-side. We photographed the natives with their picturesque huts, their outdoor ovens, their little plantations of bananas, coconuts, and papaws, their churches of coral limestone, their babies, and their sunny smiles. We could not photograph their soft spoken accents and their polite endeavors to please, but these remained in our memory as part and parcel of the languorous atmosphere of that land of mellow sunshine. We visited the wharves crowded with native sponging boats and other craft loaded with sisal and the tropical fruits of the outer islands. We lingered often in the

Mutton guaranteed absolutely fresh is sold on the hoof in this part of the market

Fleets of native boats bring sponges, sisal, fruits and vegetables from other islands



The gardens of Nassau are filled with many-colored tropical blooms so luxuriant that they overflow the garden walls and droop into the streets

market place, where the colored population of every shade mingled with the whites as they bartered for mangoes, limes, pineapples, melons, and vegetables, freshly unloaded from the boats tied to the neighboring wharf. The public market is a masonry building, with walls pierced by a succession of arches guarded by iron gratings. Inside we passed through aisles between fruit and vegetable stands, and made our purchases, sheltered from the heat of the tropical sun. The semi-obscurity of the interior was in vivid contrast with the succession of brilliant outdoor pictures framed by the arched openings. On one side, we glimpsed the blue harbor with its white-sailed boats. Yonder, a confusion of schooner prows loomed close at hand; decks heaped high with island products; gangplanks busy with the traffic of unloading, and the passing figures of dark-skinned stevedores. Through the wrought iron grill of the street entrance we could see natives, clad in vivid colors, passing back and forth in interweaving processions, straight-backed, ebony-faced figures, balancing baskets on their heads. In the background, across the sun-flooded street, lined with shops, the vista formed by a narrower side street was visible, overhung by balconies, and a cathedral tower outlined against the sky.

The inhabitants, both white and colored, were greatly interested in our operations. All the British officials, from the Governor and his Council down, gave every facility that we could desire. The delightfully hospitable English families that form the backbone of Nassau received us into their homes, while the dusky-skinned natives aided us with beaming smiles. As the result of their courtesy in the two short weeks of our stay we were able to go far toward picturing the real life of Nassau, and to obtain many photographs bearing on the sponge and sisal industries, those important factors in its prosperity.

We explored the ancient forts still standing on the heights of the island.

Fort Fincastle, on the summit of Bennett Hill, was built in 1794 by Lord Dunmore, who, after having been royal governor successively of New York and Virginia, in the years immediately preceding the American Revolution, was later appointed governor of the Bahamas. The thick-walled bastions of the old fort are still surrounded by a moat, now dry. We entered through a narrow, arched doorway, and, ascending a flight of stone steps, found ourselves standing within the fort enclosure among ancient dismounted cannon. Scaling the ramparts by the aid of the rusting gun carriages, we obtained a magnificent view of Nassau, spread out before us in the tropic sunshine. The fort is now used as a signal station, and pennants are displayed from a tall flagpole to announce the approach of vessels.

Fort Charlotte, on the heights to the west of the city, was also built by Governor Dunmore. Beneath it are passages and chambers cut from the solid rock, which, tradition says, were once used as dungeons. Another tradition states that a secret passage leads half a mile to the eastward, to Governor Dunmore's mansion. This still stands, and is used as a Roman Catholic rectory.

On the shore overlooking the eastern entrance of the harbor, about two miles from the town, is old Fort Montagu, built in 1746. This was captured by the Americans during the Revolution, and held for a short time. Later it was taken by Spaniards from Cuba, who held it until 1783, when it again fell to the English.

The island of New Providence has always been closely associated with troublesome times in our own country. In the early part of the eighteenth century it was the headquarters of pirates, especially of the notorious Edward Teach, the "Blackbeard" of pirate lore. His ships preyed upon the commerce of the American colonies until he was killed in action with two American ships in 1718. During the Revolution, the Bahamas were the refuge of tories, and, at the time of the Civil War, Nassau attained sudden and great prosperity as the center of blockade-running activity. In more recent years another wave of wealth overflowed this tropical city when rum-running was at its height. Its entire history seems to have been a succession of stirring and romantic events alternating with periods of tropic languor and somnolence. Many of its inhabitants suddenly rose to considerable wealth and temporary prosperity, later to pass through straitened circumstances.

To the sojourner in its midst, Nassau is redolent of romance and adventure, with evidences on every hand of a historic past. While it draws a moderate sustenance from its plantations and the ocean round about, it is ever ready to rouse itself to take advantage of the turn of events, especially when adventure is in the air. Perhaps the traditions of buccaneering days still linger among its inhabitants. Nevertheless, its hospitality to the traveler is unbounded, and weaves a

The strong fiber obtained from the sisal plant rivals hemp for the manufacture of cordage

The expeditionary fleet receiving its gasoline supply. The largest vessel, the "Seminole" carries 3000 gallons and the "Iolanthe" 2000

spell of charm and beauty which draws him irresistibly to return again and again.

THE TRIP TO ANDROS

On the eleventh of July the yachts "Seminole" and "Iolanthe," with the Phipps party and our Museum colleagues aboard, arrived in the harbor, and the next day, after taking on gasoline and additional provisions, we got under way for the coral lagoons of Andros. Our destination was Mangrove Cay, about sixty-five miles away, where two years previously our Museum expedition, with the aid of Mr. J. E. Williamson and his wonderful submarine tube, descended to the bottom of the sea outside the famous Andros barrier reef, and made studies and photographs of the living corals. At that time we succeeded in transporting about forty tons of coral growth to the American Museum, and since then our skilled artists have been engaged in preparing and coloring it for the great artificial coral reef in process of construction in the Hall of Ocean Life. Our purpose, on this occasion, was to secure studies of the reef fishes themselves, as well as sketches for the great panoramic background to be erected about this exhibit. Through the liberality of the Messrs. Phipps, father and son, the houseboat yacht "Seminole" and several subsidiary launches were provided for this purpose, while Mr. Phipps, Jr., who is a born sailor and fisherman, was to act as commander of the

The "Iolanthe," lying at anchor in the lee of Little Golding Cay, on the Andros reef. The photographs on this page are by Roy Miner, Jr.

fleet and of the actual fishing operations. Mr. Phipps, Sr., with his family and several guests, accompanied the expedition as visitors, on board the sea-going yacht "Iolanthe," and engaged in game fishing during the first week of our stay at Andros. The "Seminole" is a gasoline-driven, twin screw vessel, 115 feet long at the water-line, and with a draft of about four and one-half feet. It is well equipped with staterooms and baths, dining room and social room, as deck structures, and with adequate kitchen facilities, including ice machines. We fitted up a workshop on deck, forward of the social room, which in turn was used as a general meeting place and for laboratory purposes. The after deck was set aside as an artists' studio. The vessel had a crew of eight men under the command of Captain Nelson.

The Museum party, besides the writer, included Mrs. Miner; Mr. Chris E. Olsen, modeler; Mr. F. L. Jaques, artist; and Mr. Roy W. Miner, Jr., as assistant to Mr. Olsen.

The "Iolanthe" proceeded to Andros ahead of the "Seminole," which, owing to various delays and its slower speed, put into Clifton Harbor, at the west end of New Providence for the night. Here, after darkness closed in, the water became brilliantly luminescent with light-producing jelly-fish, ctenophores, and other marine organisms. Large squid were swimming about apparently prey-

Mr. John H. Phipps with two of the hound fish shot by him from the deck of the "Seminole"

Above at the left,—a nurse shark captured by the expedition being hauled aboard the "Seminole." (Photograph by C. E. Olsen.) Upper right,—raising fish pots containing tropical fishes caught on the outer reef. Just below,—fishing for green morays with a three-pronged grange. Lower left,—a catch of spiny crayfish; center,—Roy Miner, Jr., casting a rock hind; right,—finished molds of fishes cast for the Museum's new coral reef group

ing upon them. We swung a powerful gasoline lantern just clear of the water and succeeded in spearing a number of the squid that were attracted by the light. They were light colored, mottled with bright orange patches.

The next morning we were under way before daybreak, and reached South

Bight entrance of Andros Island early in the afternoon, where we found the "Iolanthe" awaiting us. This anchorage was not roomy enough for our vessels, so while Mrs. Miner and I went ashore in a launch to pay our respects to Commissioner Forsyth at Mangrove Cay, the two yachts sailed outside the reef and proceeded to Middle Bight entrance, seven miles farther north, and anchored in Hog Cay Channel. As this was not close enough to the reefs, we soon transferred our location to the lee of Little Golding Cay, our anchorage of two years before.

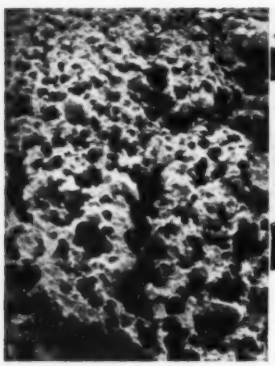
Our first task was to set the fish traps in the neighborhood of the outer reef. Five of these were placed with the aid of the launches, and, by the next day, were beginning to yield catches of brightly colored reef fishes. These were placed in aquaria as soon as they were brought aboard, so that color sketches might be made by Mr. Jaques. A captive fish in an aquarium soon begins to fade. It is necessary, therefore, to make color records immediately, if our fish models are to be accurate. Again, many species of fish undergo more or less rapid changes of color, apparently at will, or in response to varied stimuli, even in their natural environment. It is desirable to record so far as possible the range of these changes.

As soon as each fish was colored, it was brought to Mr. Olsen to be cast. A plaster mold was made, in two pieces, one for each side of the specimen, in such a way that when the mold was finished, and the two halves placed together, melted beeswax could be poured in through an opening, and thus produce a wax cast of the entire fish. During three weeks' work on the reef, more than sixty of the most representative species of reef fishes were cast and sketched in color. Specimens were also preserved in fluid, for reference. This will make possible the construction of lifelike reproductions of the typical fish fauna of a coral reef, with all its natural coloration.

The younger Mr. Phipps, aided by his friends, Messrs. Lee Bradley and Winston Guest, and his younger brothers, Messrs. Michael and Hubert Phipps, succeeded in spearing a number of the larger parrot fishes. Yellowtails, trunk fishes and slippery dicks were taken with hook and line. Mrs. Miner caught in this way a four-foot barracuda. The gill net was used for "passing jacks." Mr. Phipps obtained hound fishes with a shot gun. The best success, however, attended the use of the fish traps. These secured for us parrot fishes, squirrel fishes, blue, black, and black and yellow angels, butterfly fishes, groupers, spotted hinds, nigger fishes, beau gregorys, blue heads, striped grunts, red snappers, margate fishes, and many other species. The molds and sketches of all these have been brought back safely to the Museum, and will be entirely adequate for our purpose.

Mr. Jaques also secured a full series of sketches of the reef surroundings, including notes on the vegetation and sky and water effects, to be used in painting the group background. Those who have seen the remarkable sky dome which he painted in the bird hall of the Museum as a setting for the flying bird exhibit, anticipate another notable achievement by him in this new undertaking.

About one thousand still photographs were taken in the course of the Nassau and Andros expeditions. More than half were secured by Mrs. Miner and myself, while fine series were taken by Messrs. Olsen, Jaques, Phipps, and



THE "BLUE HOLE" ON GIBSON CAY

Above.—Spearing parrot fish at the "blue hole," a landlocked pool, connected with the open sea by a subterranean passage. (Photograph by C. E. Olsen.) Below, left,—The rain- and wave-eroded rock of the disintegrating Gibson Cay; center,—a weird corner of the pool; right,—Mrs. Miner holding aloft a fragment of the porous rock

Roy Miner, Jr. These will be of value not only as assets to the educational lecture resources of the Museum, but also as authentic records to assist us in preparing the new group.

The cays in the neighborhood of the reef presented features of great interest. On Gibson Cay, at the entrance of Middle Bight, are two landlocked and nearly circular salt-water pools, known among the natives as "blue holes" from the color of the water. The larger is about two hundred yards in diameter, and the smaller is about half that dimension. Both are of great depth and have a subterranean connection with the lagoon outside, where similar circular submarine "blue holes" form their outlets. When the tide rises, the water is sucked in through the external openings, in each case forming a whirlpool, and the tide rises in the pools within the cay. When the tide ebbs, the opposite phenomenon occurs. Within the landlocked pools are many marine fishes, often of large size, which have found their way in through the subterranean passages. As the water is very quiet and transparent, it is possible to see them as clearly as in an

aquarium. A number of our largest parrot fishes were speared here.

The outlet of the larger hole is on the north side of the cay, situated in the midst of a coral bar in shallow water. At low tide it is possible to walk out through water about three inches deep, to the edge of this submarine chasm. The shallow sea bottom here is completely carpeted with small living corals. These are of various beautiful shades of color and produce a remarkable effect as seen through the thin layer of transparent water. At the edge of the hole we peered down to unknown depths. As far as we could see, its sides were lined with magnificent living corals overhanging the pit with their rich foliate expansions, the successive growths gradually melting into the blue as the eye failed to penetrate the watery shadows. The rock of the entire island is of porous æolian limestone, and is much disintegrated by rain and wave erosion. As we walked over it, we could peer down through a network of cavities, where rain- or sea-water pools were visible. In the more elevated portion of the island the pits are small, shallow, and on the surface. Nearer to the shore they become deeper, and end in spherical cavities. At a still lower level, these cavities are seen to be connected with each other, to form larger, but still miniature caverns, or continuous chambers, the former partitions of which have dwindled to pillar-like supports. When the region of wave erosion at the water's edge is reached, the roofs of these caverns have collapsed and washed away, leaving the irregular and grotesquely shaped pillars tapering upward to terminate in sharp pinnacles. It is evident that the limestone is eroded by acid rain water which pits the rock and, as time goes on, deepens the cavities, enlarging them till they unite with each other to form continuous caverns, to be finally unroofed by the assaults of the dashing surf. The cays were doubtless once much higher, but are now in the last stages of disintergration. Apparently the same process has taken place on the mainland of Andros with modifications, and in combination with wholesale subsidence of the land mass, as shown by its maze of intersecting waterways.

During these days life on the reef was very pleasant. Except for occasional rain squalls, the weather was delightful. The trade winds continually blowing from the east counteracted the effect of the burning July sun, and it was hard to realize that in New York, so many degrees farther north, the streets were sizzling in heat. The tropical sea was almost unbelievably blue, and the shallows in the lagoon here and there showed broad bands of brilliant emerald, of a hue impossible to find in any artist's color box. The trade wind clouds heaped themselves into huge billowy towers, at times reaching almost to the zenith, dazzling white against the blue dome of the heavens. Every evening the sun sank in a blaze of gold and scarlet, flecked with burnished cloudlets. Sometimes the cloud towers were silhouetted against the sun in dark finger-like masses, edged with silver. These divided the sunlight into great rays that shot their fan-like radiance up into the zenith, beyond which they converged once more in the extreme east, producing a huge banded arch across the entire sky. Mr. Jaques succeeded in recording some of the most remarkable cloud effects by means of a camera equipped with a ray filter. For two weeks our work was carried on in a tropical paradise.

CLOUD FORMATIONS IN THE BAHAMAS

The towering cumulo-stratus clouds are characteristic of this region of trade winds. They are often piled in snowy white masses reaching nearly to the zenith, their bases flattened out into stratus formations where they rest on denser layers of air near the sea. At sunset they are illuminated in colors of almost unbelievable splendor. (Photographs by F. L. Jaques.)

THE HURRICANE

On Saturday, July 24, our glass began to go down. A swell was working its way in from the Tongue of the Ocean. The wind was swinging north of east. That night the moon was at its full and seemed very large in the heavens, across which light-flecked clouds were scudding. The tide was unusually high and, completely burying the reefs, covered the entire beach on the lee side of Little Golding Cay. The thirty-foot launch "Barbara" was tugging at her anchor not far from the beach. The next morning, Sunday, was clear, but a strong wind was blowing from the northeast. Nevertheless Olsen went ashore on Andros in one of the launches to do some collecting. The launch was to pick him up later in the day at Mangrove Cay, not far from Commissioner Forsyth's residency. As the glass continued to fall and the wind became stronger, Captain Nelson decided we were in for a northeast gale and determined to ride it out. We already had two anchors with heavy chain cables out forward. We had begun to strain at these, so he lowered a third anchor attached to an inch-and-a-quarter rope hawser. This hooked deeply into the sandy bottom, and the Captain confidently asserted our ability to ride out any storm that night.

About three in the afternoon the launch arrived with Commissioner Forsyth aboard. He at once hurried to the captain's cabin and, after a short conference, the latter appeared and informed us that a West Indian hurricane was sweeping toward us and was due to arrive at any moment. Mr. Forsyth had received the information from a native fishing boat, which had been sent over from Nassau for that purpose, as we had no telegraphic or wireless communication. Since our anchorage was practically in the storm's path, it would be impossible for us to hold on where we were. The Commissioner advised us to get up our anchors at once, and he would endeavor to pilot us to a place where we would be reasonably safe if the storm did not strike too far in shore. We immediately set about this and at the same time sent a launch over to Little Golding Cay, to get the younger Mr. Phipps and several others of the party who had landed there earlier in the afternoon. Mr. Phipps, Sr., with his family and guests, had returned to Miami in the "Iolanthe" the week before, so that we had to depend entirely on the "Seminole" and her subsidiary boats. About this time Olsen was seen approaching from the mainland of Andros, tossing about in a native sailboat. Our launch picked him up. He had heard on shore about the approaching storm and had decided to come out and warn us without waiting for us to send for him. Meanwhile we had started our donkey engine to raise our anchors, but, to our chagrin, found that their chain cables were twisted about each other and were badly fouled. We had to lower a couple of sailors over the bow in rope-slings to disentangle them. This was a difficult task as the sea was now running very high and waves were continually washing over the men as they desperately struggled with the refractory chain loops. It took two hours to get the chains free, and then the engine was started once more to haul them in, only to break down. So all hands had to get to work and raise the heavy anchors by man-power. By this time the angry sea was high above the outer reef, which thus offered no protection, and huge waves were rushing upon us in swift succession. The wind was blowing a gale, and the vessel was tugging

and straining at the single rope hawser which was now left. Meanwhile we found she had been dragging in a direct line toward the rocks of Goat Cay, a half mile to leeward. With our powerful gasoline motors going full speed, we managed to head about before the wind, and then cut our cable with a couple of axe-blows. We were none too soon, for we just missed the rocky shallows of Goat Cay, as we headed in toward Middle Bight entrance.

These so-called bights are really straits that run entirely through Andros Island to the west shore, and divide it into four parts. We succeeded in penetrating the strait for ten miles and anchored behind a projecting point in comparative safety. The storm continued to increase all night and was at its worst about four in the morning. At daybreak we looked back toward our old anchorage and saw continuous processions of black cloud masses flecked with white, marching swiftly up the Tongue of the Ocean in the direction of Nassau. All about us the tossing water of the Bight was as white as milk, due to the soft, calcareous mud which had drifted through from the sponge banks on the western shore of Andros. During the night the wind had shifted counter-clockwise from the northeast and was now blowing from the south and southeast. We were forced to remain in our sheltered position for three days, when the storm had abated sufficiently to permit us to make our way out to the Bight entrance, near Gibson Cay.

That morning an American coast-guard cutter came down the Tongue of the Ocean looking for us. She had been sent from Miami at the request of Mr. John S. Phipps, who had been greatly concerned about us. She had Captain Lind of the "Iolanthe" aboard as guide and pilot. We now learned that the wireless towers of Nassau were down, leaving her with no communication with the world, and that considerable damage had been done at Palm Beach. This was the first of the series of hurricanes that have so devastated the West Indian region during the past few months, and was totally unexpected, as they are seldom known to occur before August or September. We sent telegrams back by the cutter to inform the Museum and our families of our safety, and she started back to Miami. She had not been gone long when we heard a familiar humming in the air, and, looking up, discovered that a hydroplane was approaching from the northwest. When it was immediately over us it planed down, and, alighting on the water, taxied up to us.

"Is this the house-boat "Seminole"?

"It is."

"Is everybody safe"?

"We are."

"Well, Mr. Phipps is worried about you."

Apparently the hurricane at Palm Beach had been so severe that Mr. Phipps felt it necessary to take every means to learn of our safety at the earliest possible moment. As a matter of fact, we had come through with no casualties except that our largest launch, the "Barbara," had been driven ashore, her keel torn off and her propeller bent. During the next few days, however, she was overhauled by the captain and crew, and put into as good repair as possible.

Now that the hurricane was over, we returned to our work on the reefs. We had already accomplished practically all that we had set out to do. Our series of sketches and molds was nearly complete, and we had taken many photographs. We had not, however, accom-

The hurricane of July 25 wrought great damage in Nassau. Trees were uprooted, houses blown down, and fields laid waste. Two later hurricanes completed the destruction

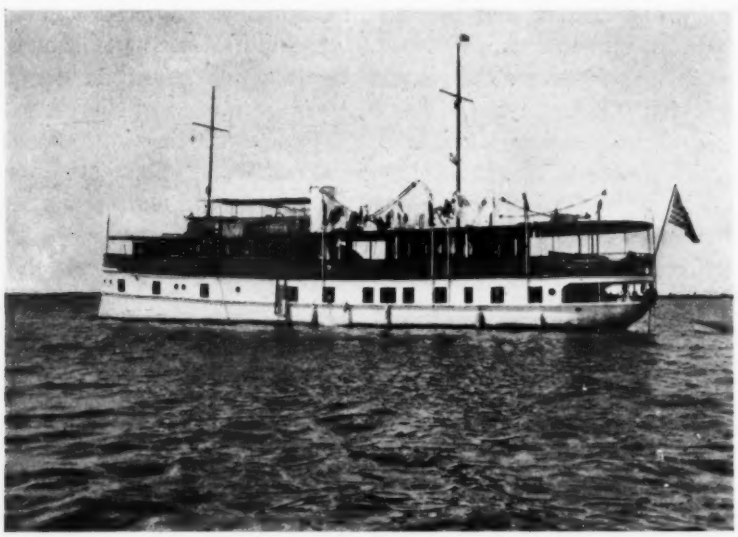
plished the diving that we had planned and for which we had come equipped with diving hoods. We now found that the white mud or marl, from the west shore of Andros had been driven completely through the Bight to the lagoon at the eastern entrance, and had so clouded the water that diving was out of the question, and even the fish would not bite. After a day or two the mud had settled and we resumed our fishing, obtaining a number of species that we were still anxious to get. The sea was still somewhat rough and it was not until toward the end of our stay that conditions were favorable for submarine work. Nevertheless, Mr. Phipps, Jr., Mr. Olsen, and Mr. Lee Bradley, as well as myself, managed to do some diving during the last three days. In the meantime Mr. Phipps, Sr., had returned with the "Iolanthe," and on the morning of August fourth, that boat was detailed to take Mrs. Miner, my son and myself back to Nassau, that we might obtain pictures for the Museum showing the damage wrought by the hurricane. The swift "Iolanthe" made the passage of sixty-five miles in five hours, and we were in Nassau by breakfast time. After landing us, the vessel immediately put back to Middle Bight and escorted the "Seminole" to Miami, stopping at Bimini on the way.

When our section of the party reached New Providence, we were amazed at the change that had been wrought by the hurricane. The whole island appeared to have been swept by a blight. Nearly every tree had been either stripped bare of foliage or the leaves were dry and withered, due to the suction of the terrific winds. Scores of trees were uprooted, or stood grotesquely maimed, with torn stumps where leafy branches had been. In Nassau, masonry churches were completely demolished or unroofed, many

of the frame dwellings reduced to kindling wood, steel telephone poles bent double as if made of tin, and every tree on the Parade laid prostrate. Many of them were centuries old, and had withstood countless storms. The water front was strewn with wrecked vessels, while at least forty others, including many of the sponge fleet from the outer islands, were blown out to sea through the harbor entrance and were never heard from again. Fortunately there was no loss of life on land, but many crews of the vessels must have been drowned. Four bodies drifted ashore within the harbor. The wharves and buildings along the waterfront suffered severely. One large storehouse for liquors, built of concrete blocks and elaborately ornamented with columns of masonry, was completely demolished by the force of the wind, scarcely one block being left standing on another. Many houses escaped miraculously, while others immediately adjoining were destroyed or at least unroofed. The damage had been largely confined to the path of the storm and the more substantial buildings everywhere remained comparatively unscathed. The beautiful flowering vines and shrubs and blooming gardens that so attracted our attention a few weeks previously, were masses of tangled wreckage, while royal palms had lost their graceful tops and now stood with one or two bedraggled plumes, like roosters after a cockfight.

The people of Nassau, however, were calm and cheerful and went about the business of repair with undaunted spirit. They were as cordial and hospitable as ever and related their experiences and narrow escapes with evident thankfulness that the event was no worse, though it was everywhere agreed that it was the most terrific hurricane since that which laid waste the island in 1866.

We spent ten days photographing scenes of damage, and on August 15 sailed for New York with all the objects of our trip accomplished and our minds filled with memories of storm and sunshine in tropic seas that we shall not soon forget.



The houseboat yacht, "Seminole," the floating headquarters of the expedition

Scenes in the Isles of June

PHOTOGRAPHS BY EUNICE THOMAS MINER

and other members of the American Museum Expedition to the Bahamas, 1926

A HUMBLE HOME IN THE TROPICS

Many of the natives live in small houses of coral limestone, thatched with palmetto and embowered in tropical vegetation. They are often surrounded by small plantations of bananas, coconuts, and alligator pears. Where the soil is not too stony, it yields a variety of vegetables. Photograph by Sands, Nassau

TYPICAL BAHAMAN CHARACTERS

Left,—"Old Flowers," a native of Andros, living in Nassau. He carries his purchases in a primitive basket made of two palmetto leaves. The two stems form the handle. Middle,—the watermelon is balanced on this boy's head as the proper way of carrying it, not as a juggling act. Right,—two sisters in Andros. The mother has died leaving a family of eleven children. They live in a primitive thatched hut of two rooms

Returning from market one sunny morning this picturesque native lad attracted our camera but refused to have his picture taken until he learned that we were admiring his fish

The market. Bringing home the milk. The animated milk bottle at the left will afford a continuous family supply. Goats replace cows as milk producers because of the scarcity of pasture land

Diving on the Andros reef. Upper left,—Captain Nelson placing a diving helmet on Mr. Olsen's shoulders. Upper right,—the diver descending. Photographed by John H. Phipps. Below,—the sea bottom with growths of living coral. This picture was taken through the Williamson tube during the expedition of 1924

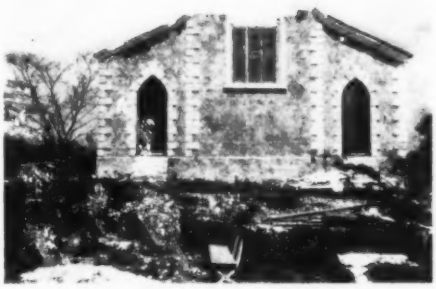
Mr. Jaques sketching in color a recently caught butterfly fish (*Chætodon striatus*). These little fishes, fluttering among the corals, readily suggest their terrestrial namesakes

Mr. Jaques making sketches for the background of the new coral reef group for the Museum's Hall of Ocean Life. Goat Cay on the Andros Reef

Mr. John H. Phipps mending a gill net after a catch of passing jacks (*Caranx chrysos*). These fishes formed a welcome addition to the expeditionary larder

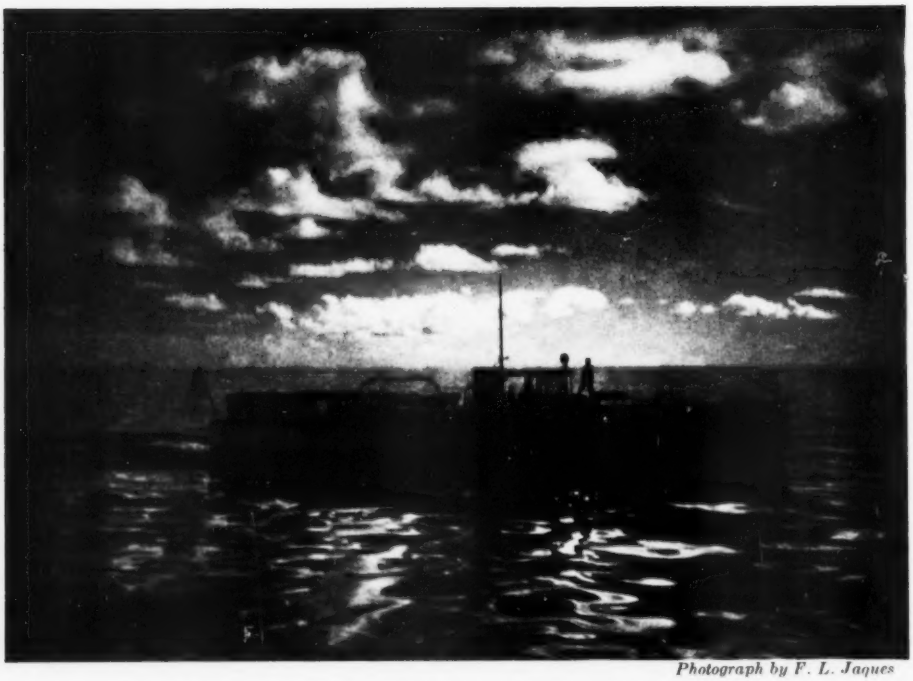
Street scene in Nassau.—Halfway down the hill a *Poinciana* spread clusters of scarlet, while, rising from its midst, a royal palm pierced the tropic sky

A quaint side street dominated by the tower of the cathedral



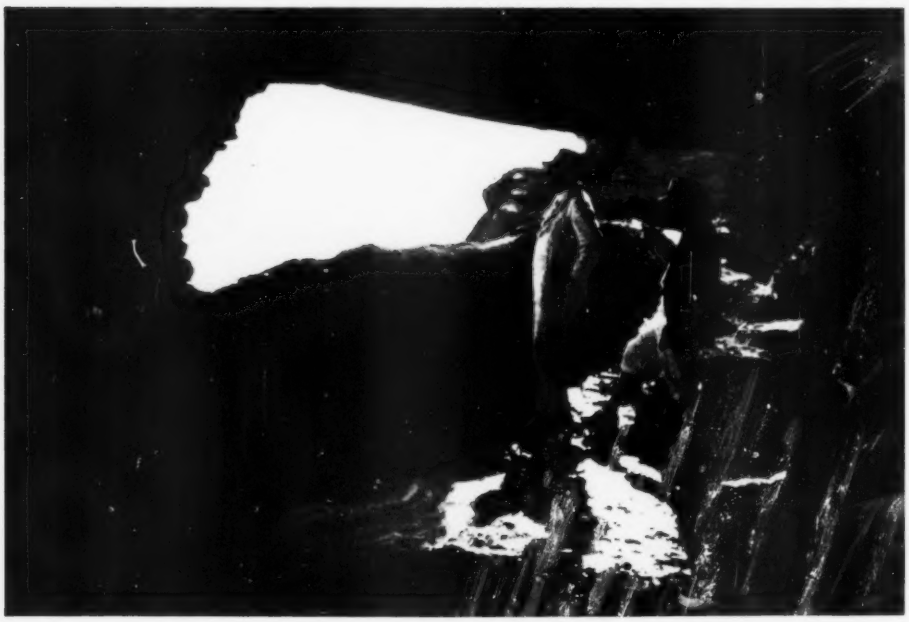
SCENES IN NASSAU AFTER THE HURRICANE

Above,—steel telephone poles bent like paper. Center, left,—St. Ann's church with spire and roof blown away. Center right,—a native church completely demolished and even the altar broken. Below,—a study in topsy-turvydom

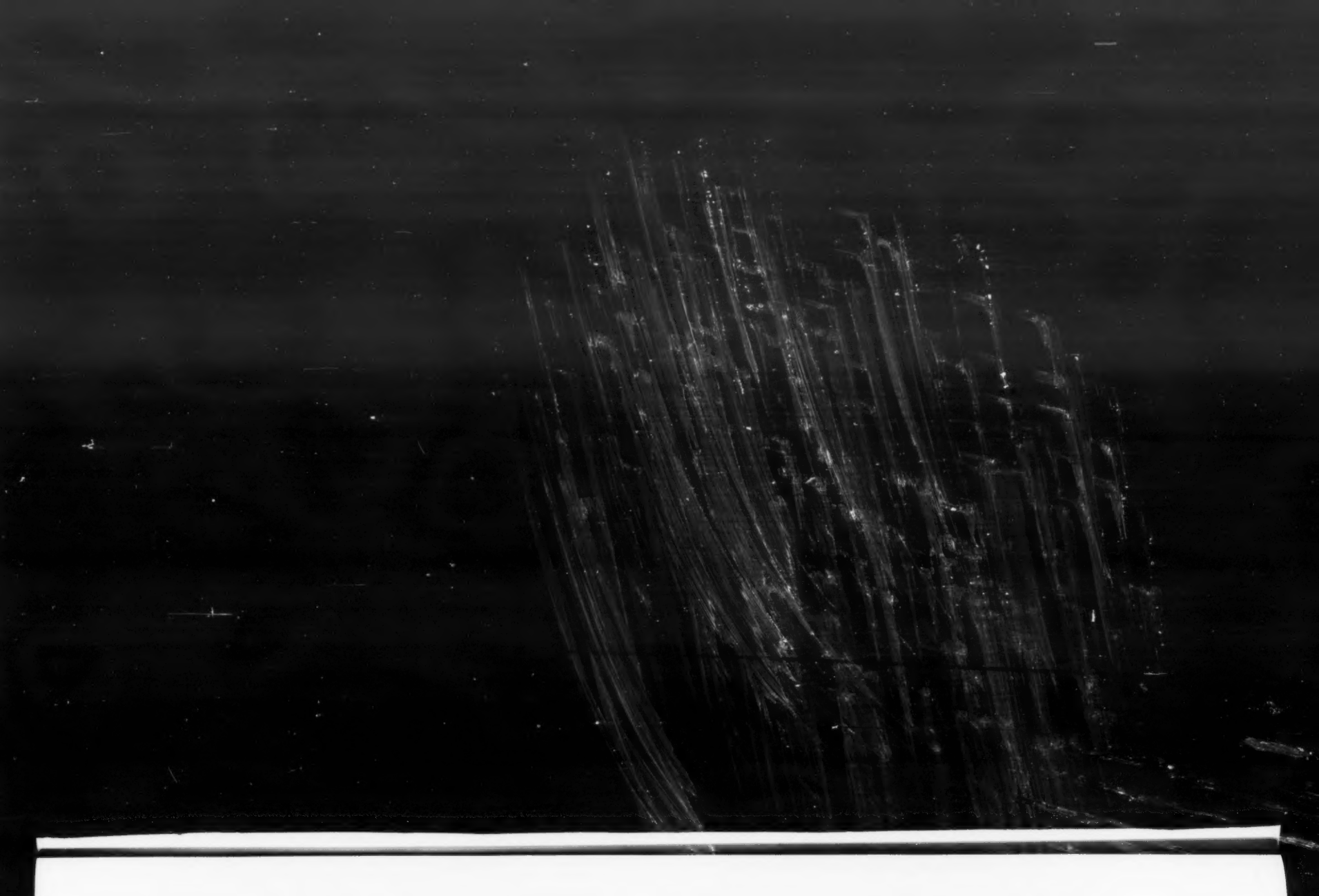


Photograph by F. L. Jaques

The "Iolanthe," floating in the evening light. A Bahaman sunset baffles description



In Jane Gale's Cavern. This remarkable cave has been eroded by the sea in the cliffs at the West End of Nassau, cutting through successive petrified beaches with shells of sea animals imbedded in the rock formation



The S. S. "Victoria"—Akutan Island. Photograph by M. L. Thompson

Impressions of Alaska,—Where East and West Approximate

By J. T. NICHOLS
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ALASKA, or more particularly the Bering Sea area, is a region in contact with notable seasonal migrations of fishes and whales by sea and of birds by air It is an area which has been significant in dispersal migrations of the past, lying as it does between the faunæ of two great continents, Asia and America, and also, in a way, between those of two great oceans, North Pacific and North Atlantic across the Arctic basin. It was with this in mind during the past summer that the writer spent a month or two of relaxation from Museum laboratory and library work in a general reconnaissance of northwestern waters and shores.

North and west of the state of Washington there are two routes of travel: one may either strike out to sea or follow the deep sounds and channels of theBritish Columbia coast. This latter is very reminiscent of the rugged rocky shore of Maine, only on a larger scale. There are no valleys to speak of, save the one intricate many-armed valley now occupied by the sea. The land consists of hilltops, for the most part clothed with an evergreen forest. Except under the actual shadow of the trees almost everywhere naked rock is in view. This is not in weathered outcrops but in solid masses, seemingly planed smooth and into straight or rounded outlines by some gigantic glaciers of the past. Beyond superimposing the forest upon this terrain, the heavy precipitation of the present day has altered it but little. The scenery almost everywhere is fine, often of striking grandeur. When at sundown, the breeze is hushed, and the nearer and more distant hills of vari-

ous shades of turquoise blue are reflected in the mirrored surface of the water, here and there broken by a streak of silver in the wake of some swimming guillemot, the scene is one of surpassing beauty. It is so still that

glaciers which cling high on a mountain-side, and great glaciers which sweep down to the sea to form a wall of ice across the heads of one or several narrow fjord-like bays. But there are small mountains and large mountains,

An Aleutian Island shore, where the dull grayish song sparrow is almost as large as a towhee; and one of the ordinarily alpine rosy finches feeds on the sea beach. Photograph by M. L. Thompson

one can hear the patter of the birds' feet on the water as they rise.

Thus one comes to the southeastern boundary of Alaska, that American territory of land and sea which stretches away to the northwest until it all but touches the old world of Asia. At once one seems to notice a change in the character of the land. The Rocky Mountain system which, in higher latitudes, has been edging west, seems now to be actually looking out across the great ocean. There are mountains and groups of mountains, close to the shore line or rising faintly against the sky above their foothills inland. There are naked rocky summits broken by frost and scoured by avalanche, long slopes and valleys, little

those that seem rugged and new beside others seemingly softened by the touch of time and erosion. In fact the variety is such that out of simple, even conventional units is built up a confusion impossible for a casual observer to reduce to any system. Still farther northward, and stretching away to the west in the Alaskan Peninsula to the Aleutian Islands, mountains of a volcanic nature are the rule in a land whose scenic beauty could scarcely be excelled.

Northward of the line of the Aleutian Islands, the Bering Sea shore of Alaska takes on an entirely different character. It is mostly low tundra, with the weathered hills well in the background. The shore front in places is cut by the

sea, into a bank of soil of some height varying according to exposure. Both shores of Bristol Bay are low and treeless, no less so than the south shore of Seward Peninsula, where there is an occasional headland of some elevation but little indentation of the shore line between such headlands. The streams about Nome also fit into the landscape as though it were made for them without apparent interference from recent glacial conditions. Which are the older, these hills or Bering Sea? If the hills, would not there be some evidence of aggrading, which there is not? Were the two perhaps coincident? How did this area escape recent glaciation? By insufficient precipitation? Its precipitation is much less than that of the coast farther south, more to leeward of the ocean.

At present Alaska's principal economic distinction is her fisheries, as in the past it has been her gold, and in the future may be air lines of communication which curve northward towards the pole between the four corners of the earth. This possiblity, in line with the distribution route of animals in geologic time, has now, however, the appearance of being improbable,—lack of communication with the outside and between its parts being the one handicap everywhere apparent to the progress and development of the territory.

Northbound along the "Inside Passage" in July, the first interesting cetacean (whale or porpoise) to be noticed was a black and white porpoise, *Phocoenoides dalli*, reminiscent of a similarly boldly marked but unrelated species (*Lagenorhynchus cruciger*) of Cape Horn seas.[1] *Phocoenoides* is related to the common harbor porpoise, or "puffing pig," (*Phocaena phocoena*), but nothing could be more unlike than the actions and appearance of the two. The latter rolls its back and fin out and under again with scarcely a ripple; the former breaks along the surface, splashing an amount of white water disproportionate to its size and the part of its body that comes into view. This species was first seen in British Columbia waters at the north end of Vancouver Island, and though not common, was noted at various points all the way northwest on the east side of the Gulf of Alaska. It seems to travel in small groups of from two to a half dozen individuals, and can be recognized at some distance by its manner of breaking. This is so characteristic that distant schools of porpoises off shore midway between the islands and Seattle (53° 36′ N. 145° 37′ W. to 52° 19′ N. 137° 42′ W.) were referred to it with confidence. It seems so different in life, that one cannot but be pleased that Doctor Andrews has separated *Phocoenoides dalli* generically from *Phocaena*.[1]

A station for the capture of the larger whales by steam whalers, situated on Akutan Island close to Unimak Pass between the Pacific and Bering Sea, is taking these leviathans of the deep (whale oil is good for making soap) at a rate which may be expected to deplete their numbers for that immediate vicinity in a very few years. The greater number are finbacks and humpbacks, with a few blue, right, and sperm whales. It is surprising to see what different looking animals are the trim, slender finback and the long-armed humpback, if one is given the unusual opportunity to see the two hawled out of water. They can also be differentiated at sea, to be sure. Not

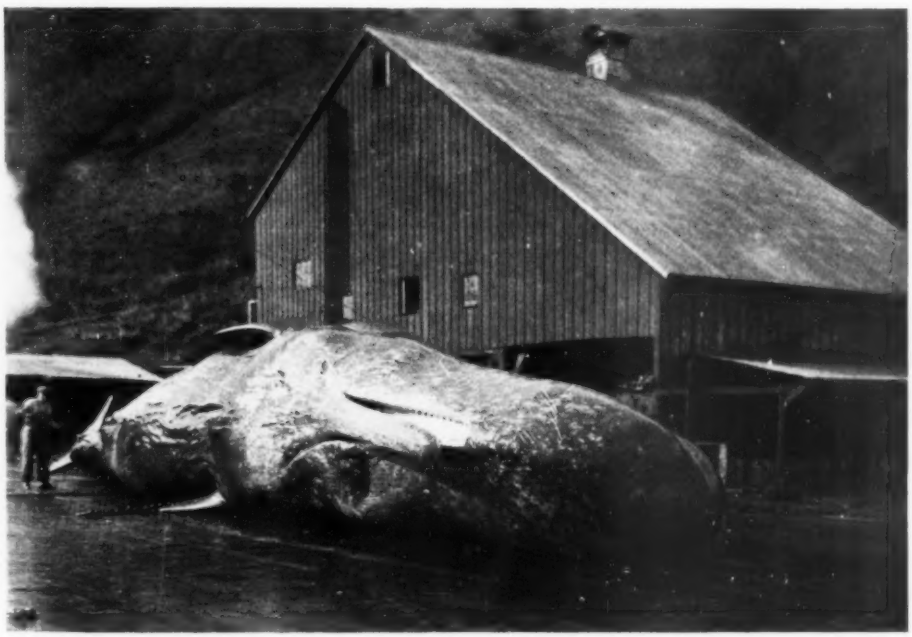
[1] *Bulletin of the American Museum of Natural History*, 1908, XXIV, p. 219, fig. 3.

[1] *Bulletin of the American Museum of Natural History*, 1911, XXX, p. 34.

The whaling station on Akutan Island.—Notice the sharp V-shaped groove cut by each little rivulet which courses the gentle grassy slopes of the hill. Photograph by Al. S. Oliger

Finback whale hauled out at the Akutan Whaling Station. The birds in the background are glaucous-winged gulls. A few ravens are also present about the station. Photograph by Al. S. Oliger

Pacific right whale. The once valuable whalebone from this species is now of comparatively little worth, since whip handles and corset stays have gone out of fashion. Photograph by Al. S. Oliger



In summer the seas about the Aleutians are so little Arctic in character that an occasional warm-water sperm whale is taken at Akutan. Photograph by Al. S. Oliger

only is the finback's fin higher and better defined, but its spout is less scattering, going up straight and tall like a fountain, when there is not much breeze. The humpback commonly lifts its flukes above the water as it disappears.

Aside from the whaling station, the landscape about the harbor on Akutan Island is not only very beautiful but exceedingly interesting. The gentle, graceful curves of the sloping hills are clothed in delicate green grass, without a tree to hide a single detail of their outline. From the point of view of erosion they show every appearance of maturity, but with this maturity as a background, the imprint of a recent uplift is shown also, for each little brook that descends their slopes has cut a sharp V-shaped gorgelet down which it tumbles to its present baseline at the sea. There is also evidence of sea-carving on the cliffs high above the present level of the ocean, where just such a cave as is cut by the wash of the waves may be seen. One may contrast this condition with the flat valleys opening to salt water between hills at the east end of Unimak Island (only a short distance farther east); hills which are almost identical with those at Akutan.

The fur seal in the water, off shore in Bering Sea, is a slender, graceful, dark-colored, active animal, very different from the true seals or the ponderous northern sea lion. Not having seen the Pribilofs, one may mention it only, and pass to the salmon fishery.

The various species of Pacific salmons, particularly the smallest with bright red meat, called locally "redfish," are here taken in almost incredible quantity. The redfish, which is the same species as the blue-back salmon of the Columbia or the sockeye of Puget Sound, enters fresh water to spawn in streams tributary to cold lakes which serve as nurseries for the young before these descend to the sea. There are various and extensive lakes of this sort about Bristol Bay, a broad funnel-shaped arm of Bering Sea which cuts deeply into the outline of the mainland just north of the Alaska Peninsula. In seasons of a good run such as the present one (1926) waters outside the rivers which empty into the head of the bay are glutted with this particular salmon. The fish are caught in drifting gill nets from staunch double-ended boats, each with a sail, two pairs of oars, two men, and no power. The method is almost identical with that employed at the mouth of the Columbia. It calls for daring and resourceful seamen, for whereas Bering Sea summer weather is, as a rule, one of light breezes and smooth water, there is always the possibility of a sudden gale from the north or northwest in which a salmon-laden boat will prove quite unseaworthy. The funnel-like configuration of its shores gives the head of the bay tides of considerable magnitude, and the tidal current racing out or in and the coldness of the water add to the danger. This year seven fishermen were lost here in one blow.

One of the most remarkable faculties possessed by the Pacific salmons is the ability, when they meet in the sea the taint of fresh water from the particular type of drainage favorable to their spawning, to recognize it and follow it to its sources. Thus the redfish crowd into Bristol Bay which is fed by lakes, and but a few stray king salmon are taken among them. According to one of the fishermen he took only about twenty-five of them among the thousands of salmon which fell to his net this year. The large king salmon by

preference enters major rivers, such as the Columbia and the Yukon.

Conservation of Alaska's salmon supply is a problem of very great importance to the country, and one to which much thought is being given. The interesting life history of Pacific salmons has been the subject of careful study and in a general way is now fairly well understood. Data on their age and growth have been obtained from microscopic examination of the scales of large series of individuals. Methods for taking salmon eggs and hatching them artificially have been perfected. The catch of fish in Alaska is so vast, however, that it cannot be materially effected by hatchery work on any scale practicable at present. More imperative are restrictive laws and closed seasons in relation to conditions as they arise in different localities.

As regards hatchery work, so far, it has proved impossible to obtain any reliable information as to the return of artificially hatched fish, when adult, after they have obtained their growth in the sea. No method of marking has been devised that will last over this period of growth and give reliable data. Due primarily to this fact, one finds a certain scepticism as to the value of hatchery work, which is, however, not at all justified. In nature there is a great wastage of salmon eggs and fry between the time the former are deposited and the latter are scattered through the little pools and shallows bordering the parent stream, each, by that time, a small fish able to care for itself in the narrow confines of such an environment. Spawn artificially taken and hatched may, on the other hand, be returned to the stream as small fishes with negligible loss. There is no question that the process can be carried out so as to pay for itself and be a powerful conservation agency, if each step is taken in the right way. The important one of scattering the planted fry in shallows natural for them must not be overlooked.

That salmon in large numbers run north into Bering Sea from the Pacific, prior to spawning, is thoroughly well established by the heavy catches made in the pass between the Alaska Peninsula and Unimak Island. Data seem to be lacking as to the extent to which they move north and south seasonally during their years of growth in salt water. Here is another point: various unrelated bits of data tend to show that the present season (1926) was one where warm water conditions extended unusually far to the north along the coast. It was also one of a heavy take of salmon at False Pass (entrance to Bering Sea) and in the Bristol Bay area of Alaska. Is it possible that the run of salmon, as a whole, shifts more to the north during such warm seasons? This would be a contradiction to the hypothesis that each individual fish seeks its parent stream. It may be, however, a mere coincidence. But let no one suppose, from the amount of knowledge that we do already possess concerning Pacific salmons, that their life history and migrations are thoroughly known.

Alaskan fisheries are fortunate in having a center for investigation into all things pertaining to them, close at hand, in the College of Fisheries of the University of Washington, Seattle. Here information is obtainable not only regarding the various marine animals which form the bases of the fisheries, and the practices relating to their capture and utilization, but experiments are going forward, in the mechanics of fisheries and in chemistry, to determine the best method of treat-

ment for the fisheries' products. This college of fisheries, the only one existing in America, has a certain peculiar interest in that it is a center of special learning and at the same time articulates with and in many ways is directly helpful to a vital industry. At present its facilities are thrown open to an international investigation of the Pacific halibut fishery, members of the staff of which the writer found at work in one of the college buildings. They are obtaining data of considerable natural history interest, which should also prove of economic importance, but it would be premature to speak of the results so far obtained.

The Pacific halibut seems to be the same as that found in the Atlantic, and it is possible that the fish has a continuous range in deep water across the Arctic basin. It will be a triumph for modern scientific conservation if the considerable Pacific halibut fishery can be maintained without depleting the supply as it has been depleted in the Atlantic.

A thorough oceanographic investigation of waters from Puget Sound to Bering Strait with special regard to various fishing would be worth while from many points of view. The local and off-shore currents, even the potential fishing banks of this area, are imperfectly known. In July and August the writer found comparatively warm-water conditions prevailing farther north than he had anticipated. Coming in southeast, west of the Queen Charlotte Islands, when about the 52d parallel of latitude was reached, there was a band of water several miles wide, thickly strewn with *Velella*. The glistening sails of this little animal dotted the smooth blue surface of the sea as the falling petals of apple blossoms do the grass under apple trees. South of this line phosphorescent ctenophores flashed their sparks of blue light in the ship's wake at night. Again, farther southeast, a fragile pelagic stalked barnacle was numerous. Several of these barnacles float attached to a central globular mass seemingly of the same structure as that of their stalks. At about 50° north, the steamer passed close to a sea sunfish three or four feet across, swimming in a vertical position, its upper fin projecting somewhat above the surface of the water.

A codfish which is almost identical with the Atlantic cod occurs in very large numbers about the Aleutian Islands. Such differences as one would notice in a boatload of fish are only of the degree that one would expect from the somewhat different character of the fishing grounds in Atlantic and Pacific. The Bering Sea cod is the basis of a fishery doubtless capable of some development. Taken by dories from three-masted schooners, salted at sea, and landed in Seattle, it meets the Atlantic species in the salt-fish market. There is no reason to suppose that at present cod occur in the Arctic basin either to the east or to the west, connecting these Pacific cod with their Atlantic relatives. On the other hand, within comparatively recent times, there must have been such a crossover.

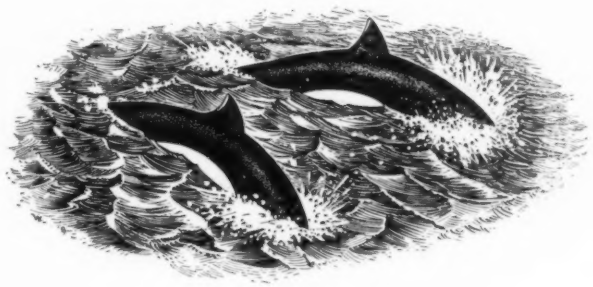
It would be out of place here to try to fit the writer's diverse field observations into the hypotheses of migration and dispersal (dependent or independent of physiographic and climatic changes) on which they have a bearing. But it may be mentioned in passing that it is only reasonable to suppose that the cod family is of Atlantic origin, since it is so much better represented in the Atlantic than the Pacific. The seasonal changes in

Bering Sea, to which Pacific fishes are unaccustomed, probably have enabled it to find room there unoccupied by Pacific forms.

In contrast with the cod, which is scarcely distinguishable from our Atlantic fish, the Alaska pollack, food of the fur seal, is quite different, being specialized away from anything occurring in the Atlantic and classified in a separate genus, *Theragra*. The writer was interested in watching a school of them, fish about eighteen inches in length, swimming lazily not far below the surface under the shadow of the steamer's side as she lay at the wharf at Akutan. Sluggish, slender fish, they are probably capable of supporting life on comparatively slight rations. Perhaps the weight of numbers of the salmon in Bering Sea has, by competition, forced some heavier more salmon-like pollack to specialize in this direction. When, in winter, the salmon cease to come north, *Theragra* doubtless takes advantage of having the sea comparatively to itself, and one can fancy it sucking into its capacious mouth many a young salmon making a first voyage in yet unfamiliar water.

If Pacific cods have come from the Atlantic it does not in any way follow that the crossover between the two oceans has been in the same direction, from east to west, for other groups of marine fishes. For similar reasons it seems more likely that the sculpins, for instance, crossed from Pacific to Atlantic. The Arctic has a specialized fish fauna of its own, but there is no indication of passage from one of the larger oceans to the other through intermediate Arctic forms, though the Arctic fauna seems entirely derivative from one direction or the other.

Such crossover of marine fishes as there has been between Atlantic and Pacific appears to be comparatively recent, and to have been possible under conditions not very different from those existing at present. Whether it is taking place under present-day conditions can only be determined by further investigation of the Arctic basin, and such investigation would therefore have considerable theoretical interest.



Black-and-white porpoise of the Northwest

AN ANDEAN SPINNER

The native women are seldom seen idle and when their hands are not otherwise engaged they spin. A loose tuft of the wool is twisted on the end of a stick and then fed out gradually as a coarse strand which is twirled into thread or yarn and wound on to a spindle. Long practice makes the fingers adept, and the yarn is even and free from lumps. The woman's dark skirt is made from homespun woollens

A Collector's Impressions of the Quichua Indian

By H. E. ANTHONY
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THE intensive studies of the mammal and bird life of Ecuador carried on by expeditions from the American Museum annually since 1920 have been the means of bringing the field parties into intimate contact with the native peoples. Some of these natives are still savage, such as the Jivaros, an account of whom was given in NATURAL HISTORY in 1921 (Vol. XXI, No. 2, pp. 146–159). Others, while primitive when judged by certain modern standards, have developed extensive cultures dating far back, which are today only thinly veneered by the aftermath of the Spanish invasion. To this group belong the Quichuas who live in Ecuador and northern Peru. While the Museum expeditions did not undertake to make ethnological studies of the Quichuas, nor was the personnel of the party qualified by experience for such studies, many interesting impressions were obtained from even the casual contacts with the life and customs of these descendants of the Incas.

The historian Prescott tells us of the conditions prevailing in western South America when Pizarro led his conquistadores against the empire of the Incas. This empire had its northern capital at Quito in what is now Ecuador, and a vast dominion stretched southward for hundreds of miles, more or less confined to the Andean region. The most important of the northern tribes which gave allegiance to the empire were the Quichuas. They tilled the soil, tended flocks of llamas, maintained the extensive systems of mountain trails and irrigating ditches, and carried on an industrious livelihood at elevations of 8000 to 13,000 feet above sea level. The Incan form of government imposed strict obediance to authority and tended to develop a docile and uncomplaining proletariat. This state of affairs made the task of subjugation far easier for the Spaniards than it would otherwise have been, and it is one of the present-day attributes of the Quichua that he accepts his lot as he finds it and is patient and hard working in the face of discouraging difficulties.

The simplicity and trustfulness of the rural Quichua, unsophisticated by contact with cities, was impressed upon me by incidents which took place in the Punin region, where we searched for fossil mammals. When our small pack-train filed over the eroded ash beds from Punin and headed up into a wild ravine, the Quebrada Chalan, there was scarcely any sign of human habitation. Here and there in the distance one might see evidence of cultivation, but the general impression was one of barren lifelessness. With the halt of the pack-train and the unloading of the mules at our selected camp site, the community began to stir. The unexpected arrival of strangers and the erection of a green tent on the open hillside was too much for the curious Quichuas. Moving figures cropped up on the sky-line ridges and our camp was the focus of converging attention. Indians gathered along overlooking crests and a few bolder spirits came directly down to where we were. When nothing happened to these individuals, others lost their shyness

From towering Chimborazo and near-by peaks a heavy mantle of volcanic ash has been laid down over the Riobamba region. These ash-beds are fertile and many Quichua Indians have farms in this district, so barren at first glance. Note the terraced fields in the foreground

and very soon we had quite an assemblage of very much interested spectators.

The Quebrada Chalan is open and practically devoid of any vegetation, so we were forced to scheme out some means of erecting our large tent-fly with whatever ridgepole the locality afforded. This meant cutting down a small wild cherry tree which grew at the bottom of the quebrada and which seemed to be ownerless so far as we could see. But I felt some of the George Washington complex after the

deed was done, and the raw stump and litter of twigs were damning evidence at our very tent door.

It was not long before one of the older Quichuas came up to the bank directly above the tent and noted that a tree had been cut down. He promptly demanded payment for the tree, representing that it belonged to him, but it was evident from the snickering in the crowd that he was simply trying to make the best of the situation. When he realized that he must prove ownership before he was paid, he lost his interest in the episode and we never heard from him again.

Apparently the Quichua believed that our unusual activities indicated that we were skilled in all of the higher branches and could discharge the office of priest or of doctor as well. A young man came up to me where I was excavating fossils and knelt before me, removing his hat as he did so.

"What do you want," I asked, rather impatiently I suspect.

"Your blessing," was the humble answer that made me ashamed of my impatience.

I was halted on the trail one day by a man and his wife and asked if it were not true that I could heal sickness, if I were not truly a "medico." When I replied that I was truly not a "medico" but would be glad to give whatever assistance the occasion and my limited medical kit indicated, I learned the symptoms. The man had a bad heart, so he thought, but since his troubles apparently could also be due to colitis which I could treat, I chose that diagnosis rather than heart trouble for which I could do nothing.

When I announced that I had a "remedio" for the patient, the man spoke quickly in an aside to the woman and she produced, seemingly from nowhere, two eggs which the "doctor" gravely accepted as his fee. In the Quebrada Chalan the gift of an egg is a favorite expression of esteem.

Near Molleturo, in southern Ecuador, Mr. Tate, in charge of an expedition, was approached by a Quichua who asked how long it would take him to make a pilgrimage to the Holy Land. His simple and devout mind had grasped something of the desirability of such a journey, but nothing of the physical barriers in the path of a pedestrian. A similar naïve view of the external world was expressed by a native who asked me whether a certain foreign people we were discussing spoke English, and when I replied in the negative, he said,

"Oh, then they speak Chinese."

The only foreign tongues he had ever heard were English and Chinese, hence all foreigners must speak one or the other.

These childlike concepts do not always take a harmless outward manifestation, and on two different occasions Mr. Tate has been the target for shots fired by normally well-behaved, but temporarily illusioned, Indians. Some of the Quichuas have a belief that leprosy may be cured by bathing in human blood. When Mr. Tate was collecting near Cuenca, the Indians became alarmed at the strange behavior of a man who did so many things unaccountable to them. They concluded that he was an escaped leper, from the leper colony situated between Cuenca and Cinincay, and that he was lurking about to capture a cure for his malady. Fortunately their apprehensions disturbed their aim and no serious results took place.

On another occasion, we camped on the basal slopes of Cotopaxi on an ancient lava flow. One night when Mr.

From the uppermost slopes of Pichincha one views distant Cotopaxi hidden in the clouds, and scores of cultivated fields scattered over a broad valley

Tate went hunting with a headlight, several rifle shots were fired at him. The native who did the shooting evidently thought that the spot of light, moving about where no normal-minded native would be at night, was an evil spirit and he acted accordingly. We showed no more lights about camp that night, and thereafter took particular pains to advertise in advance any night hunting we attempted.

Although I received very little tradition or legend directly from the Quichuas, I have little doubt that the material is there for the observer who seeks it. Several stories that had gained current belief dealt respectively with an enchanted lake, a man who appeared in the guise of a mountain lion, and a vast treasure buried by the Incas when Atahualpa was killed by the Spaniards and all hope of ransoming the monarch had fled.

I had pointed out to me the site of the enchanted lake, at the top of a nearly inaccessible peak. The lake was surely enchanted because it always disappeared when any one climbed up to the spot. An unusually destructive lion could not be killed because he was not an ordinary puma, but in reality a clever man disguised as a lion. Belief in the existence of the treasure has led to the formation of an unsuccessful syndicate and to the devotion of years of search on the part of individuals. There is nothing supernatural in the legend of the treasure, and while all such tales are apt to arouse skepticism, it must be confessed that the account

While most of these fields today are owned by Ecuadoreans of Spanish descent, this region was formerly a stronghold of the Inca empire and farmed by Quichuas

of the lost ransom of Atahualpa as it was told to me was a fascinating and plausible story.

The Quichuas are a musical people and have their own instruments for the production of their native airs. One of the commonest instruments is a series of graduated tubes of bamboo, like the pipes of Pan, played by blowing across the open ends and producing a flutelike tone. This piping requires a great amount of air, and I wondered how the boy who visited us in camp on Pichincha, 13,000 feet above sea level, could find the breath to lilt his tune as he trudged along the trail. We had no breath to spare at this elevation and when we walked we kept our mouths shut.

There is a peculiar minor quality to the Quichua music. Just what Quichua airs may be indigenous or to what extent they may have been modified by European influences, I am not competent to judge, but the strains sounded original and, furthermore, seemed to have latent possibilities for adoption into modern scores. I was told by Señor Jijon of Quito, who has made an exhaustive study of his country's prehistory, that the Quichuas have had an extensive musical experience.

At a festival in Loja I saw a Quichua orchestra of one musician who played a flute with his right hand and beat a drum with his left, providing dance music for four young Indians who danced and gestured to the rhythm. During the same fiesta I saw another Indian flute player, who

was also a devotee of Bacchus, stop a passer-by and carry on what might be described as a musical monologue. He addressed his flute to his audience of one and with great earnestness and gravity proceeded to search the depths

The clear, flutelike notes of the Quichua pipes carry far on the mountain air, a melodious interlude in the hush of early morn

of his repertoire. The incident served to demonstrate to me that love of music was a fundamental instinct with this Quichua who had reached the stage in his celebrations where his very equilibrium was threatened.

The Quichua still does many things in the way of his forefathers. His farming methods are crude in the extreme, from the plowing with a wooden plow to the threshing and winnowing by slow hand processes. While one sees many cultivated fields, it is seldom that a large and bountiful harvest is seen and the yield is inadequate to the long hours of labor that the Indians spend over the crop.

These farmers are adept at side-hill cultivation, and in a fertile section the fields of grain, peas, alfalfa, etc., are perched on the sides of the mountain slopes with a fine disregard of gravity. In many places one can still see today the traces of the old ditches, built by the Incas to irrigate these high Andean fields, at elevations of 12,000 and 13,000 feet.

The landscape in one of the agricultural sections is most interesting and unusual, presenting as it does the aspect of a gigantic patchwork quilt made up of broad, geometrical outlines of brown, green, and yellow, depending upon whether the field is plowed, is growing grain, or is ready for harvest. Add to this the ever-present fence of green cabuya, related to the century plant, and the simile is completed by stitching around the margins of each patch.

When soil is to be prepared for sowing, the Quichua yokes his oxen, mules, burros, or horses, or any combination of these animals, and they drag a rough wooden plow, sometimes scarcely more than a sharpened stick, over the field, scratching up shallow furrows. In some of the best agricultural sections where great, level expanses exist, modern plows may be seen, but most of the cultivation done by the Quichua is by the old-time method and, perhaps, on certain of the steep slopes, it is about the only practical method.

When the crop appears above ground, apparently it is left much to itself, as we saw little to show that nature was being assisted. Some pulling of weeds

It is little wonder that the Quichuas love their mountains and remain an upland people. The sight of Cotopaxi, rearing white across the green of mountain meadows, is alone worth a trip to Ecuador

About Punin one sees a network of the cabuya hedges marking off the cultivated fields. While the hills beyond look desolate, they are the home of many Quichuas

Perched among the hills about Punin are many Quichua homes where cultivated fields are on edge and the Indians travel far for water

An ancient stone corral on the flanks of Antisana, facing Cotopaxi, was the nightly bedding ground for a mixed flock of black and white sheep

Grain is staked in neat symmetrical piles which look almost as if they were the work of a landscape gardener who trimmed them with shears

The Quichua yokes his oxen to a crude wooden plow and turns a slow, laborious furrow but, patient as his team, seems well content

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The Quichua wife is often seen wearing a large silver pin, the "topa," which she will not sell because it is a token of her marriage

All rope used by the Quichua is made from the fiber of the cabuya plant. Great piles of this cordage are brought to the market at Riobamba

Loads of heavy red pottery are brought to market, the various pieces tied together with the cabuya rope, and borne on the backs of the Indians

Matting woven from palm leaves or other similiar material is used for beds or placed upon the ground to give a clean, flat surface

may take place. After the grain is cut down, the threshing is done by driving horses, mules, or cattle over the stalks which are scattered over a hard, earth threshing-floor. Finally, the resulting mixture of chaff and grain is winnowed by pouring it from bowls on a day when the wind is strong enough to divert the light chaff,—the plump,

Everything the typical Quichua wears is homemade. This boy has on a heavy wool hat and his poncho is made of wool, spun, dyed, and woven by his family

heavy grain falling at the feet of the harvester.

The Quichua women are inveterate spinners and one seldom sees a woman without her spindle, which is simply a slender reed or splinter weighted by a small potato or other handy object. The yarn is spun from wool grown on their own sheep. The ponchos and all of the woolen fabrics used by the Quichua are hand woven. Cheap cotton fabrics, woven by power mills, are marketed in the towns, but the Quichua of the high Andes places more reliance upon the warm cloth of domestic manufacture.

Other native industries are the making of pottery and the twisting of rope and cordage. Clay suitable for the structure of jars, pots, tiles, etc., is of fairly common occurrence, for all through Ecuador one sees the ever-present, red-tiled roof and the dark-red water jars, cooking pots, and pottery vessels. The Incas were noted for their achievements in this field, and seemingly the Indian of today utilizes the same processes, although by no means with the same degree of artistic skill. In the native markets one sees quantities of the hand-made pottery for sale.

The native rope is made from the cabuya, one of the Agaves, which has a long, strong fiber well suited for cordage. This plant grows everywhere throughout the Andean plateaus, and because of the thick, spiny leaves makes an effective hedge. Most of the fences are simply rows of cabuya plants.

One seldom sees llamas in any number in Ecuador. These "sheep" of the Incas, so-called in the early Spanish chronicles, may have been common as far north as Quito in Pizarro's time, as Prescott would lead us to believe, but today they are to be found in comparatively small numbers and more or less restricted to the region about Chimborazo and Riobamba. In their place the Quichuas raise the true, domestic sheep, and rather an unusual feature of these flocks is the high percentage of black animals. The Andean meadows furnish almost exhaustless pastures for live stock, for they are always green and well watered.

Like so many native peoples, the Quichuas love to bargain, and a transaction is spoiled for them unless it passes through a lengthy preliminary. Market day is a big event in their lives and if any one offers to buy the entire load of produce that an Indian is carrying along a trail, at a figure above the market price, it will not be surprising if the Indian refuses to sell.

because then he is deprived of the joy of bargaining at the market.

The market at Riobamba is especially interesting because it draws a large attendance of Quichua Indians. While the Indians are rather given to wearing black, when one finds them about their own terrain, many of them wear brighter colored ponchos when they come to market, and in the crowded plaza bright reds, yellows, and browns relieve the somber black homespun. The women have babies slung in cloths over the back, between the shoulders, and if the hands are free they spin as they walk. Women and men alike have huge bundles on their backs if they have produce to bring to the market. One quarter of the plaza may be given over to the display of native-made rope which lies about in great piles; another section displays various sizes and shapes of pottery vessels; a native at a sewing machine gathers a crowd about him as he stitches the brims of hats to make them stiffer; here and there, dotted on the ground where space allows, are the open-air cafés, a pot of charcoal and four or five earthen vessels with stews and unknown concoctions for the hungry passer-by.

The Quichua has a legacy of unsurpassed landscapes and grand mountain scenery. After one has watched the dawn from Pichincha, Antisana, or from any vantage point on the vast Andean upland, or felt the beneficent effects of the sun's rays after passing through an Andean rain or fog, one finds it not difficult to understand why the Incas were sun worshippers.

One of the rewards of an early start on an Andean trail is the splendor of the sunrise over lofty mountain ramparts and the rout of darkness from the Stygian cañons

THE EDWIN NATURAL BRIDGE IN WHITE CAÑON. NOTE FIGURE IN FOREGROUND

Niznaz Boko—The Great Hole in the Ground

By DOUGLAS BURDEN
Trustee of the American Museum

FOREWORD.—The following article is the result of a recent pack trip through southern Utah and northern Arizona during which the author studied the geology of the High Plateaus.

The work is based on C. E. Dutton's great monograph, "The Tertiary History of the Grand Cañon," and on W. M. Davis' *An Excursion to the Grand Cañon of the Colorado.*

To the helpful advice and criticism of Prof. Douglas Johnson of Columbia University, especial acknowledgements are due.—EDITOR.

LONG before the arrival of the white man in western America the Navajo Indians had supplied themselves with a satisfactory explanation as to the origin of Niznaz Boko—the Great Hole in the Ground. When the Colorado River on its initial journey to the sea, so they asserted, found itself confronted by great mountainous plateaus thousands of feet high, the River gods burst these high plateaus asunder, thereby forming the Grand Cañon and allowing the river access to the sea.

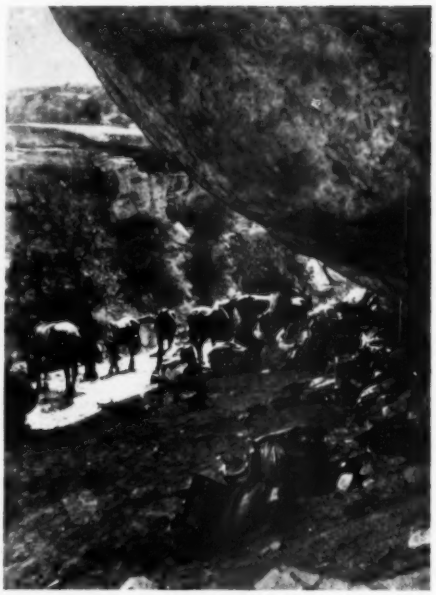
To the Navajos the explanation was simple yet sufficient. Not long ago white men were asking themselves the same question and it is their answer and the reasons for that answer that will be presented in the following paragraphs.

We are dealing with one of the most amazing stretches of country in the world, namely the High Plateaus of Utah, Arizona, and New Mexico. This country is the last stronghold of the wilderness in the United States—a wilderness renowned as much for its great forests as for its waterless wastes. There are deserts that stretch away in an ever shifting sea of moving sand dunes till land meets sky, their graceful crest lines seeming to undulate as our pack train winds through them. Wind ripples scour their surface in a vain attempt to destroy a pattern of most elaborate and delicate design—a woven network of tiny tracks—the imprints of the fauna of this wild land. There are painted deserts of rock whose delicate coloring, lavender, vermilion, magenta, and mauve, lure the traveler on to new discoveries. There are deserts of Palæozoic age formed of solidified sand dunes which have been covered up and obliterated for millions of years only to be reborn again—thus bridging the gap of time. There are nameless gorges on whose seemingly inaccessible cliffs innumerable dwellings have been cunningly built by a race of Indians which has long since passed on to its happy hunting grounds. There are countless cañons in this land of the purple sage; amphitheaters, recesses, caves, and stupendous natural bridges hewn from the living rock whose masterful masonry and noble carving defy description. The attention of the traveler is forever absorbed in the great works of nature, be it in the weird contours and exquisite coloring of the slick rocks, in the great outpourings of igneous material which once devastated the land with a deluge of molten lava, or in the formidable red and white cliffs that present a well-nigh impassable barrier to the wanderer beyond the clay hills. It is a land of chasms within chasms and plateaus superimposed upon plateaus —a veritable rainbow land in which earth and sky reflect each other's glory.

THE EDWIN NATURAL BRIDGE IN WHITE CAÑON. NOTE FIGURE IN FOREGROUND

It is here, in this wilderness of mountain and plain, that nature has surpassed herself. Evolution is one of her illimitable laws by which she avoids monotony and manifests herself in never ending change. This great law is applicable as well to the physical evolution of the earth's crust as to its flora and fauna. In the region of the High Plateaus the history of its physical evolution may be traced with a remarkable degree of accuracy. The method by which this evolution has taken place is that of erosion following uplift of the land. The scale of the Tertiary Erosion of these great plateaus is almost beyond the power of the finite mind to grasp.

The vertical range of this erosion in the Grand Cañon district is 16,000 feet and its horizontal range extends for a distance of more than 140 miles. An average of no less than 10,000 feet of strata has been stripped from an area ranging between 13,000 and 15,000 square miles.[1] This means that approximately 28,000 cubic miles of rock have been removed by the Colorado River from the region of the Grand Cañon.



Camp in White Cañon

In the slick rock country of Southern Utah

In dealing with so great a subject which, when studied in detail becomes infinitely complicated, it will be necessary here for the sake of brevity to limit the discussion to the major and most striking features of the great denudation.

In the first place it should be understood that the vast measures of sedimentary strata in the High Plateaus represent the accumulation of material derived by the erosion of pre-existing land surfaces in Palæozoic, Mesozoic, and even in Cenozoic times. In the Palæozoic era the region of the High Plateaus was a great geosynclinal trough below the level of the sea. The Palæo-Cordilleran Mountains to the west and the Palæo-Rocky Mountains

[1]Dutton, C. E. *Tertiary History of the Grand Cañon District*, page 61.

Many of the undercut cliffs shelter ruins of masonry houses occupied by Indians in pre-Spanish times

to the east were the origin or source of the great thicknesses of strata that were piled up on the floor of this Palæozoic sea. These formations are now exposed in the great gorge of the Grand Cañon and the unconformities that exist there are evidence that the deposition was not continuous. More than once the sea retreated and long periods of erosion set in.

During the Mesozoic era another epicontinental sea spread northwestward from the Gulf of Mexico covering New Mexico, Arizona, and Utah, and lapping up against the Meso-Cordilleran Mountains which occupied the region of the present great basin. This must be regarded as a shallow sea, the floor of which was subsiding simultaneously with the accumulation of sediment upon it. In this era no less than 10,000 feet of strata were deposited. During the Eocene a gradual change was taking place from marine to lacustrine conditions and, finally, with the close of the Eocene uplift it brought about the emergence of a new land. From now on our story deals with the Tertiary erosion of this land.

It will be well, before entering upon our discussion, to examine the meaning of the two words erosion and denudation. When more accurately defined, erosion signifies the sum total of all processes by means of which rock particles are cut away from the mass to which they are attached, whereas the word denudation is applied to the lowering of a land mass by the combined action of weathering, erosion, and transportation.

In any country such as the High Plateaus where the formations are approximately horizontal, the drainage channels will at first dissect the land, thus creating cañons. The in-

Cliff of the Upper Colorado. Denudation takes place here primarily through the recession of cliffs

ward-facing cliffs formed by these cañons are then exposed to all the forces of destruction so that they will gradually retreat.

Erosion is not very effective when attacking the surface of plateaus for, when the strata are horizontal or nearly so, the plateaus or uplands are covered by a protecting mantle of waste. Under such conditions, denudation resulting from erosion plus transportation takes place primarily through the recession of cliffs, and the speed of retreat of any given cliff is dependent on its height and on its resistance to the agencies of weathering. If, however, the talus at the base of a cliff accumulates until the whole face of the cliff has been covered, erosion will progress but slowly until the protecting waste has been removed. Softer formations will break down to form a more gently rolling topography. The erosion of the cliffs forming the boundaries of the High Plateaus must, therefore, have been differential. Due to differences in height and durability they have receded at different rates.

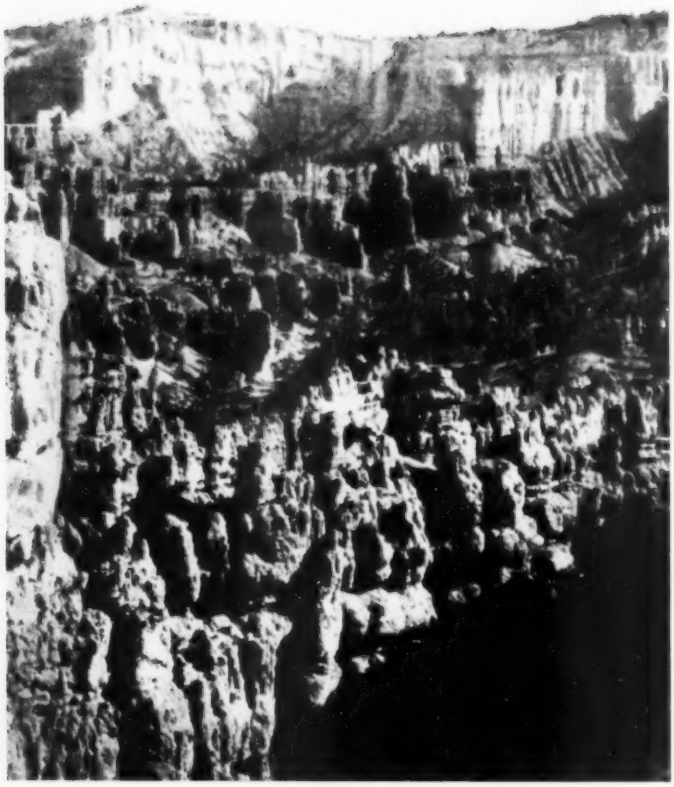
Now let us turn back to the new land that by the end of the Eocene had emerged from the sea. First of all, a drainage system was established. The course of the rivers forming this system was consequent upon the initial slope of the land surface. Their work consisted at first of the cutting of deep channels by the process of downward corrasion and then, when a profile of equilibrium had been reached,—the carrying power of the water being just equal to its load,—of the opening up of these narrow gorges into great open valleys. The picture now is of a new land raised above the sea, dissected by rivers and then denuded by a stripping off of the strata until a large part of the area had been worn down nearly to sea level. Thus was formed the great Tertiary Peneplain. Subsequent to this period of extensive base leveling came the period of general uplift which resulted in the incision of the cañons that still exist today. Thus in the history of the Grand Cañon district we have two distinct cycles of erosion.[1]

[1]Davis—*An Excursion to the Grand Cañon of the Colorado.*

Part of a cut-off entrenched meander of the Colorado River

The Colorado River in a second cycle of erosion. Note the receding cliffs on either side

Both cycles were consequent upon orogenic disturbances. The first disturbance may have been intermittent, in which case there would be alternate periods of uplift and quiescence, each successive period of activity resulting in the rejuvenation of rivers. The evidence in support of intermittent uplift is, however, insufficient. The movements of land, although not accompanied by much folding, were differential in that different sections underwent different degrees of uplift. Due to these differential movements in the initial uplift, a series of north-south faults and monoclinal folds were established which greatly complicate the structural geology of the country. A



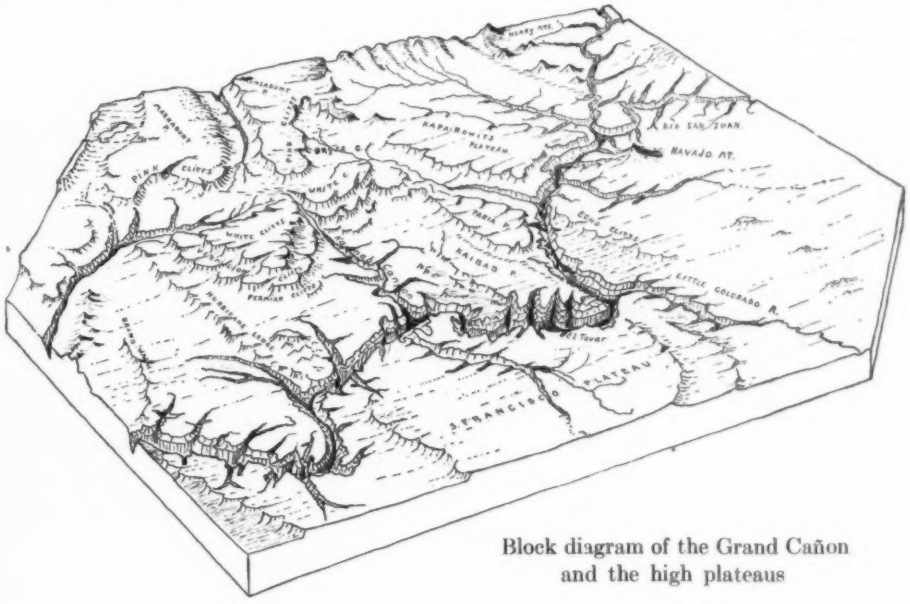
Bryce Cañon.—Erosional features of the Pink Cliffs

long period of erosion, however, beveled the area, reducing it to one of faint relief across which the Colorado River lazily meandered. Following this came the general upheaval which inaugurated a new cycle of erosion and which resulted in the entrenched meanders of the upper Colorado and the incised cañons that we see today.

Needless to say, the uppermost formations have been subjected to erosion for the longest period of time and are therefore the ones which have been more completely denuded. Between New Mexico and Bryce Cañon, a distance of 140 miles, the Eocene has been entirely stripped off. Northwest of the Grand Cañon the remains of the Eocene may be seen in the Pink Cliffs. The detail and delicacy of their erosional features have no equal. South and east of the Colorado, no Eocene is found until we cross the border into New Mexico. Over the entire intervening region it has been completely removed.

From the base of the Eocene escarpment of Pink Cliffs the traveler

journeying southward to the Grand Cañon must first cross the typical rolling hill topography of the Cretaceous. Due to the fact that the Cretaceous hills are usually covered with pine and spruce, this formation is not difficult to recognize even from a distance. Below these hills he will ride for some distance over a level platform which suddenly breaks away to form the unmistakable cross-bedded massive white cliffs of the Jurassic. From the edge of this great escarpment he will step down several hundred feet upon the Triassic platform which in its turn drops away to form the famous Vermilion Cliffs. Not far from the base of the Vermilion Cliffs are the badly eroded remains of the Permian or Shinarump Cliffs, which form the lowest and smallest step in nature's great stairway. A glance at the diagram reveals plateaus superimposed upon plateaus, the terminal southward-facing walls forming a great stairway so that one may literally step down upon successively older and older formations. There are islands of Mesozoic sediments superimposed one upon the other, with an island of Eocene beds capping them all. From the summit of the Eocene to the base of the Permian the traveler has descended, due to the northward dip of the beds, only 5400 feet in altitude, and yet he has traversed more than 10,000 feet of strata.[1]



Block diagram of the Grand Cañon and the high plateaus

And now I am going to ask my reader to reconstruct the series of formations just mentioned and to project them in his mind's eye as they would have been had there been no great denudation previous to the last general uplift which caused the incision of the Grand Cañon. In such a case the rim of the Cañon would be formed by the Pink Cliffs, the altitude of which in the Buckskin Mountain region would not be 8000 feet (the present altitude of the rim of the carboniferous platform) but 18,000 feet.

It would be useless to conjecture about the Cañon that might have been.

[1]Dutton C. E.—*Tertiary History of the Grand Cañon District*, page 47.

It appalls us and yet I can think of no better way of getting some grasp of the meaning of the great denudation. The Grand Cañon now is undoubtedly the most sublime, awe-inspiring spectacle in the world of nature. It is difficult, however, to realize as one stands on its rim that the excavation of Niznaz Boko does not represent one-tenth, nay, not even one-hundredth part of the total work performed by the Colorado within the region of the High Plateaus alone. Furthermore, as we gaze into those stupendous depths, if we contemplate the appalling slowness with which the work of erosion is carried on even in an arid climate where the formations are but slightly protected by vegetation, we begin to get some idea of the æons and æons of time that have been necessary for the High Plateaus to reach their present incomplete state of denudation.

And yet this erosion is only supplementary to very much longer periods of deposition. In the Palæozoic Age of invertebrate, fish, and amphibian life, there were vast periods of deposition interrupted by periods of erosion perhaps as long as the present one. In the Mesozoic Era—the Age of Reptiles—with a time duration recently estimated at not less than 150,000,000 years, deposition was continuous. Only comparatively recently, when the Age of Mammals had well begun, did the great denudation begin,—yet man did not appear on earth until it was nearly as far advanced as it is today. Thus we begin to get a faint concept of time and of the duration of the world that the human mind is unable fully to compass. Small wonder it is that geologic time, at best, is only relative and that the age of the world in number of years can, even under the most carefully made computation, be only a hazardous guess.

Cool nights on the desert

The Mrs. William Boyce Thompson Expedition

By ERICH F. SCHMIDT

THE southwestern area, which includes Arizona, New Mexico, the southern parts of Colorado, Utah, and Nevada, is a fertile field for the student of human prehistory. Buried in the sands of the Saguaro Desert, and the soil of the mountainous regions, hidden in caves and beneath the overhanging rocks of cañon walls, are the remains of sedentary peoples, Indians who lived here before the existence of this continent was known to white men.

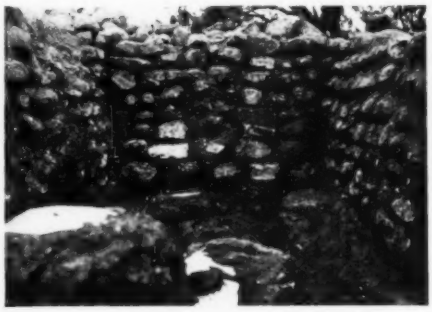
The term pueblo has been applied to this area because of the peculiar type of dwellings, honeycomb-like communal houses. During the last two decades it has been determined that the period during which these pueblo buildings were built represents only the latest stage of prehistoric development in the Southwest, and that the life of these prehistoric pueblo dwellers did not differ materially from that of the historic Indians still living at Zuñi, on the Hopi mesas and along the Rio Grande.

Three other prehistoric culture periods preceding that of pueblo building have been established by archæologists. They are named Pre-Pueblo, Post-Basket Maker, and Basket Maker. The Basket Makers are the earliest settlers in the southwest of whom we have any knowledge. They are named from the excellently made baskets found with the dead, which were buried in cists or pits dug in the floor of caves. They seem not to have made fired pottery and their houses were simple shelters which have left no permanent remains for our study. These Basket Makers were followed by the Post-Basket Makers who learned to mold clay vessels which they dried in the sun and even developed a crude kind of burned pottery. The Pre-Pueblo people who succeeded them made crudely decorated pottery. Their houses were one-family in size and stones were employed only in the building of the foundations. Soon after the pueblo building era the entire region mentioned above was occupied, but by the time the Spaniards arrived in 1540, the area inhabited had shrunk considerably. Our present interest is in this early period of the Pueblo era, since the architectural remains, the implements, works of art, and the remains of human beings here discussed are attributed to that time.

In the beginning of 1925 the American Museum of Natural History undertook explorations in Arizona under the patronage of Mrs. William Boyce Thompson, who had previously supported archæological expeditions in Crete and Egypt. The purpose of the expedition was the investigation of the Lower Gila region, an archæological subarea which extends over the greater part of southern Arizona, including the Giant Cactus Desert in the west and a mountainous country in the east. One of the most famous ancient structures north of Mexico belongs to this region, Casa Grande, near Florence. Its existence was first recorded in 1694 by Father Kino, a Spanish priest. Since very little was known about the archæological remains in the region between the Gila and Salt rivers, it was considered best first to excavate thoroughly a respresentative site in a central position and later to acquire

Upper picture—General view of Ruin Togetzoge before excavation.
Lower picture—Same view after partial excavation

comparative material by extensive reconnaissances. As a starting point a ruin was chosen which had previously attracted the attention of Mrs. Thompson. It is situated in a very fertile natural basin about half-way between



Excavated room at Ruin Togetzoge; the snow-covered earth piles are fireplaces, indicating floor levels of different depth

Metates, manos, hammerstones, and pebbles from rooms in Ruin Togetzoge. In the background is an excavated room

Superior and Miami at an altitude of 5,000 feet. The surrounding flat has been cultivated for many years by Mr. Craig, who remembers the time when the Apaches had their summer camps here. They called this basin Togetzoge, the name we gave to the ruin also. The latter is a typical communal house, containing about 120 rooms arranged in tiers and surrounded by an enclosing wall.

For the work of excavating, four San Carlos Apaches were employed. They appeared with their women and children and built their typical dome-shaped huts of branches and brush covered with rags of canvas. The ruin had first to be cleared of a dense growth of thorny bushes and cactus, many a spine finding its way into our skin. There were no walls standing above ground. The only indications of the contours of rooms were partly visible regular rows of stones. The upper part of the walls, which were built of unworked bowlders, had crumpled down in each case, often filling the rooms with hundreds of wall stones. The excavations were carried on carefully from one end of the building to the other by following one tier for a series of rooms, then working in zig-zag fashion and again cross-cutting, so as to gain all possible information in regard to the various tiers of the structure. Each room was sectioned vertically in order to determine successive inhabitations. Soon the evidences and products of the industry and workmanship of the ancient inhabitants appeared. Metates and manos once used for grinding the corn which was cultivated in the surrounding valley, stone hoes for tilling the soil, beautifully polished axes and arrow straighteners, saws, knives, arrow heads and spear points, beads, and pendants made of turquois, a pathetically crude fetish, and many other objects of stone were found. Besides these there were awls and needles made of bone, and beads, finger rings, and bracelets of shell brought here from the Gulf of California. The only metallic object discovered was a small copper bell, probably a trade piece from Mexico.

The pottery at Togetzoge, as in all the other Pueblo ruins, was of major importance: first for its artistic value, since the shapes of the vessels and particularly their decorations represent the foremost art products of the prehistoric Southwest—fabrics having disintegrated in most cases—and second for its classificatory value. In this connection it has been determined that, as a rule, within a given territory during

Gila polychrome, bowls and small olla from floor burial of the Ruin Togetzoge

Apaches with ollas mended by them. From Ruin Togetzoge

Black-on-white pottery from the burial ground at the courtyard ruin, Armer's Gulch

a definite period, one principal painted type was made, uniform in technique and style of decoration. The painted pottery made by the builders of Togetzoge was Gila polychrome, a pleasing three-color ware with black designs on a white and red background. In addition to painted bowls and jars, many undecorated vessels were found, ranging in size from miniature pots one inch high to huge ollas with a circumference exceeding six feet. To be sure, most vessels were crushed by the weight of stones and lumps of adobe which had fallen from the crumbling walls and roofs, but many pots could be restored. The Apaches, after having been trained for a short time, became quite expert in pot mending.

There were well-protected places—the graves—which yielded precious unbroken specimens without crack or scratch. The people of Togetzoge used to bury their dead in one of two ways: either underneath the floors of rooms, or in a common burial ground. The excavation of a room did not stop when the first floor level was reached at a depth of from three to five feet. There were often several floors, one above the other, indicated by hard tramped soil and also by the difference in the level of fireplaces, which were round holes sometimes plastered with clay and containing ashes and charcoal. When the lowest floor level had been reached, and the holes in which had stood the posts which supported the roof were found, the floor was examined for places with soft soil. Almost invariably, burials were discovered at such spots. The skeletons were often found lying in an artificially widened groove of the bed rock.

Mrs. W. B. Thompson, who took active part in the excavations and restoration of specimens, herself uncovered the richest of these room burials, the grave of a woman. The skeleton was extended at full length facing north, with four Gila polychrome vessels placed near the head and left arm. Nearly 500 black, red and white beads, made of stone and shell, were gathered from the soil near

the skull. Many of the beads were clinging to the jaw bone and to the upper vertebræ, indicating that as a highly prized possession they were once arranged in three strings decorating the neck of their owner. Two shell rings were on the fingers of the left hand, and a bone awl was found in one of the bowls. Three feet away was a grave containing the skeleton of a child, accompanied by two unpainted bowls, one on the bone of the right hip the other near the right foot. Both woman and child were buried underneath the wall, with their feet extending into the adjoining room an indication that they were probably interred before this wall was built.

The most exciting incident of the work at Togetzoge occurred when, at last, after a long and systematic search the test trenches struck the common burial ground. There were no surface indications at all suggesting the presence of burials underneath. The number and character of surface sherds were the same as everywhere else. There was no elevation indicating a "burial mound," no fragments of bone were found brought to the surface by rodents, as noted at other localities. When we first started work in this grave-yard, the Apaches felt somewhat uneasy, and Nat, who was a kind of a Medicine Man, said he would much prefer to work in the rooms where there were not so many dead people. One day, while he was cutting off the surface soil, kneeling near an exposed skeleton, he suddenly jumped up and ran away. When asked what the matter was, he said:

"Hair going up, betsintsin (skull) hollering like chicken, I no more working."

It took quite a bit of friendly scolding, combined with practical demonstrations of the absolute dumbness of the skull—by brushing and petting it—to make Nat continue his work. Otherwise he was the best worker of the crew.

In addition to the important osteological specimens, a large number of beautiful pottery vessels were recovered, as well as beads, bracelets, pendants of shell and turquois, and little clay effigies representing quadrupeds. The most interesting specimen was a pot, modeled in the shape of a duck with a human face, with ears and nose perforated. Apparently the ancient inhabitants of Togetzoge observed the following customs when disposing of their dead: Initiated persons were buried in the common burial ground, their bodies extended full length in a north-south direction, never east-west. Small children, presumably those who died prior to the initiation, and also a few women, were buried under the floors of rooms.

The work of the Expedition extended over two seasons. Toward the end of the first but principally during the second season, the circle of the explorations was widened and reconnaissances were carried on within a radius of about fifty miles toward the east and the north and somewhat farther toward the west. The faithful and indispensable expedition Ford carried the reconnoitering parties to the ruins in the vicinity of Globe, Cutter, Rice, and Wheatfield in the valleys of Alizo and Pinal Creeks, and San Carlos River. All the settlements found at these localities resemble Togetzoge closely in architecture as well as in artifacts, the pottery, Gila polychrome, being the same. There was a greater abundance of specimens in the rooms of these ruins than in those of the mountain Pueblo Togetzoge. This is espe-

The temple mound of the Casa Grande in Armer's Gulch, Roosevelt Lake

Plazas of courtyard ruin in Armer's Gulch, Roosevelt Lake

cially true of the ruin near the Indian schoolhouse at Rice, situated within the San Carlos Apache Reservation. Here the Apaches, living near by, had been digging, probably in order to find turquois beads, highly valued by all the Southwestern aborigines.

"Murphy Mesa," a Pueblo near Wheatfield, was built on top of a conical hill in an excellent strategic position, overlooking the valley of Pinal Creek for a distance of many miles. Several enclosures encircling the Pueblo nucleus like terraces made a formidable fortress out of this settlement. In one of its rooms another burial was discovered. The skeleton was disintegrated, but on both sides of the skull two perfect little urns were found, one of which represented a drift piece of an exceedingly rare type. It was determined later that this had originated in the territory around Phoenix.

View from Ruin Murphy Mesa, near Wheatfield

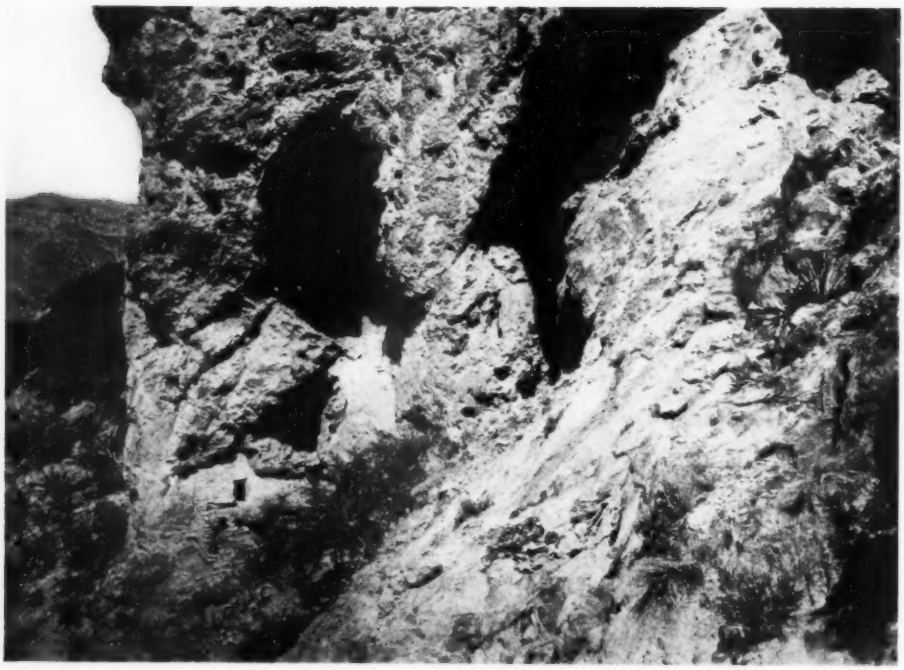
So far we have considered only the settlements to the east of Togetzoge, which were built by the close cultural relatives of the inhabitants of the former pueblo. The situation changed when we turned north. We were informed that the water level of Roosevelt Lake had receded, thereby exposing a number of ruins. It was a sad event for the farmers in the Salt River valley, dependent on the water supply of the lake, but a lucky accident for the archæologist; and Mrs. Thompson agreed that the lake ruins should be investigated in order to save as much as possible before they were again submerged. The patroness of the Expedition went on the trip herself and helped to excavate a site which yielded very interesting results. There was a series of ruins near the northeast shore of the lake, all of them below the high-water line. Here once more a burial ground was discovered, situated close to a "courtyard" ruin, which consisted of rectangular plazas enclosed by long rows of stones with a few rooms in the center and at the sides. About 1000 feet southeast of this place was another extensive ruin, composed really of two structures, one a communal house, the other of Casa Grande

type. This resembled the courtyard ruins except for an additional "temple building" originally perhaps three stories high. Among the water-worn bowlders and pebbles on the slope of the bank on which the courtyard ruin was situated, numbers of potsherds were found, but they were scarce on top of the bank. This fact led to the discovery of the burial ground, for, when the edge of the bank was cut off, disintegrated remains of skeletons appeared, fossilized through the absorbtion of lime. Parts of those nearest to the edge had been carried away by the water. This explained the large number of sherds on the slope. They were fragments of mortuary gifts. Some of the skeletons were accompanied by an abundance of beads, arrow points, and pottery. The painted pots were of a type, known as "black-on-white," a fine white ware with black designs, commonly associated with the first phase of the Pueblo period. During the course of these explorations it was determined that all the settlements, situated on the shores of Roosevelt Lake and associated with this ware were built and probably deserted before Togetzoge or any of the other "polychrome pueblos" existed. Another "black-on-white ruin" on the southern shore of the lake was closely examined. It was a two-story pueblo situated about three miles north of Spring Creek store. Here two more burial sites were uncovered, their localities indicated by low mounds covered with thousands of potsherds. These tumuli were originally refuse heaps, used secondarily as burying places. Each mound contained about ten skeletons, accompanied as usual by mortuary pottery.

By this time the Apaches were used to "dead people" and what is most surprising, they even liked them,—because they received a small bonus for every complete pot they uncovered, and complete specimens were most frequent in graves!

In addition to divergencies in certain architectural features and in ceramics between the series of ruins represented by Togetzoge and the ruins near Roosevelt Lake, there was a difference in the burying customs. At Togetzoge, as noted above, all the bodies were extended in a north-south direction, while those uncovered at Spring Creek as well as at the courtyard ruin were lying in an east-west direction. A number of criteria like these combined, show the archæologist the limits of cultural subareas, possibly coinciding with tribal territories.

An interesting reconnaissance trip was made to cliff-dwellings situated in Roger's Cañon, an arm of the well-known Fish Creek Cañon southwest of Roosevelt Lake. Joe, an old-time cowboy, was our guide, and furnished horses and packmules. After a ride of about six hours we arrived at our destination. The cañon was narrow and its walls, rising steeply from the bottom, were overgrown with trees and bushes. In one of the cañon walls were natural caves, sheltering several cliff-houses. One of the buildings was in perfect condition. It seemingly represented the main structure and had an annex in the form of an antecourt. The cave containing this building was about fifty feet above the cañon bottom and was accessible only by a narrow ledge leading up to it. In addition, the entrance was well protected by a parapet, making an attack almost impossible. There were remains of some other houses and also storage bins in the same cave and in the adjoining ones. The walls were carefully



General view of caves containing cliff houses, Roger's Cañon

Main cliff house with antecourt, in Roger's Cañon

built of alternating flat stone slabs and adobe, the adobe plaster applied on both sides still bearing the impressions of hands. When Nat, the Medicine Man, saw the houses, he said, "Fifty years, no older," and he could not be convinced that they were built long before his ancestors knew gun or horseback riding.

The final part of the exploratory work was concentrated on ruins in the vicinity of Phoenix, the beautiful oasis in the Saguaro Desert. The City Manager of Phoenix as well as the City Archæologist, Dr. O. A. Turney, had previously applied to the Museum of Natural History for an investigation of the prehistoric structures, the largest of which was city property. Their wish coincided with the plans of the expedition since the territory around Phoenix on the lower Salt River was part of the archæological area to be explored. There is no doubt that this "Lower Salt Region" is one of the most interesting and at the same time archæologically least known sections of the Southwest. The area now occupied by the city of Phoenix—the present day political and cultural center of Arizona—and its immediate neighborhood was also in prehistoric times the center of a homogeneous culture which extended from the mountains bordering the desert in the east and north, to the Mexican frontier in the south and probably beyond. Toward the west it may have extended as far as the Colorado River. Huge mounds marking the sites of structures once two or three stories high, and the remains of hundreds of smaller buildings are found along the lower course of the Salt River. Remains of irrigation canals, the most imposing products of the industry of the ancient population, are preserved in the "Park of Full Waters" east of Phoenix. Structures outside of national or communal reservations are disappearing rapidly on account of the progressing cultivation of land.

The larger buildings are accompanied by refuse deposits in the form of mounds. The depth of these rubbish heaps in addition to many other criteria indicates that the Lower Salt culture lasted for a considerable time. To the archæologist these refuse mounds are of inestimable help in determining the chronological sequence of pottery types and consequently of all the cultural features associated with the particular ceramics. By sectioning the refuse deposits, he will find the old types at the bottom and the more recent types near the apex of the mound. During our stay in Phoenix, we were principally engaged in this kind of work. By investigations of the refuse deposits of the ruins of "Pueblo Grande" seven miles east of Phoenix, and of "La Ciudad" within the city limits near St. Luke's Hospital, it was determined that the Lower Salt settlements were built by the makers of the so-called "red-on-yellow" pottery, a ware with yellowish base and red designs. At the same localities one of the most important problems of the expedition was solved: the time relations of "Gila polychrome" and "Lower Salt red-on-yellow." The fact was established that the settlements associated with red-on-yellow pottery are of much greater antiquity than the structures built by the makers of Gila polychrome, for instance Togetzoge.

In addition to the stratigraphic investigation of the refuse deposits, two rooms of the ruin "La Ciudad" were excavated. In one of them a frail but well-preserved skeleton was found buried underneath several suc-

Mound of Pueblo Grande near Phoenix

Stratigraphic investigation of the refuse deposit of Pueblo Grande

Sectioning the rubbish heap of "La Cuidad." Mound of ruin in the background

cessive floors. Due to the character of the work, only a limited number of specimens was recovered. Of particular interest were beautifully carved animal effigies of shell. Private collections in Phoenix show an abundance of pottery vessels, effigies made of stone, shell, and clay, and other artifacts. Works of sculpture, most characteristic for the Lower Salt Area, are stone cups usually bearing representations of rattlesnakes in relief. Artifacts of this type are found nowhere else in the southwest, but similar specimens recovered in Mexico, point toward southern affinity of the Lower Salt culture, emphasizing the importance of this area.

The work in the Lower Salt region concluded the explorations of the Mrs. W. B. Thompson Expedition. Altogether, several thousand specimens were recovered and much information was gathered concerning the culture and, as far as possible, the physical type of the ancient settlers. Large areas are still unexplored and many problems which arose during the investigations must at present remain unsolved, but a beginning has been made in deciphering another chapter of the fascinating prehistory of the southwest.

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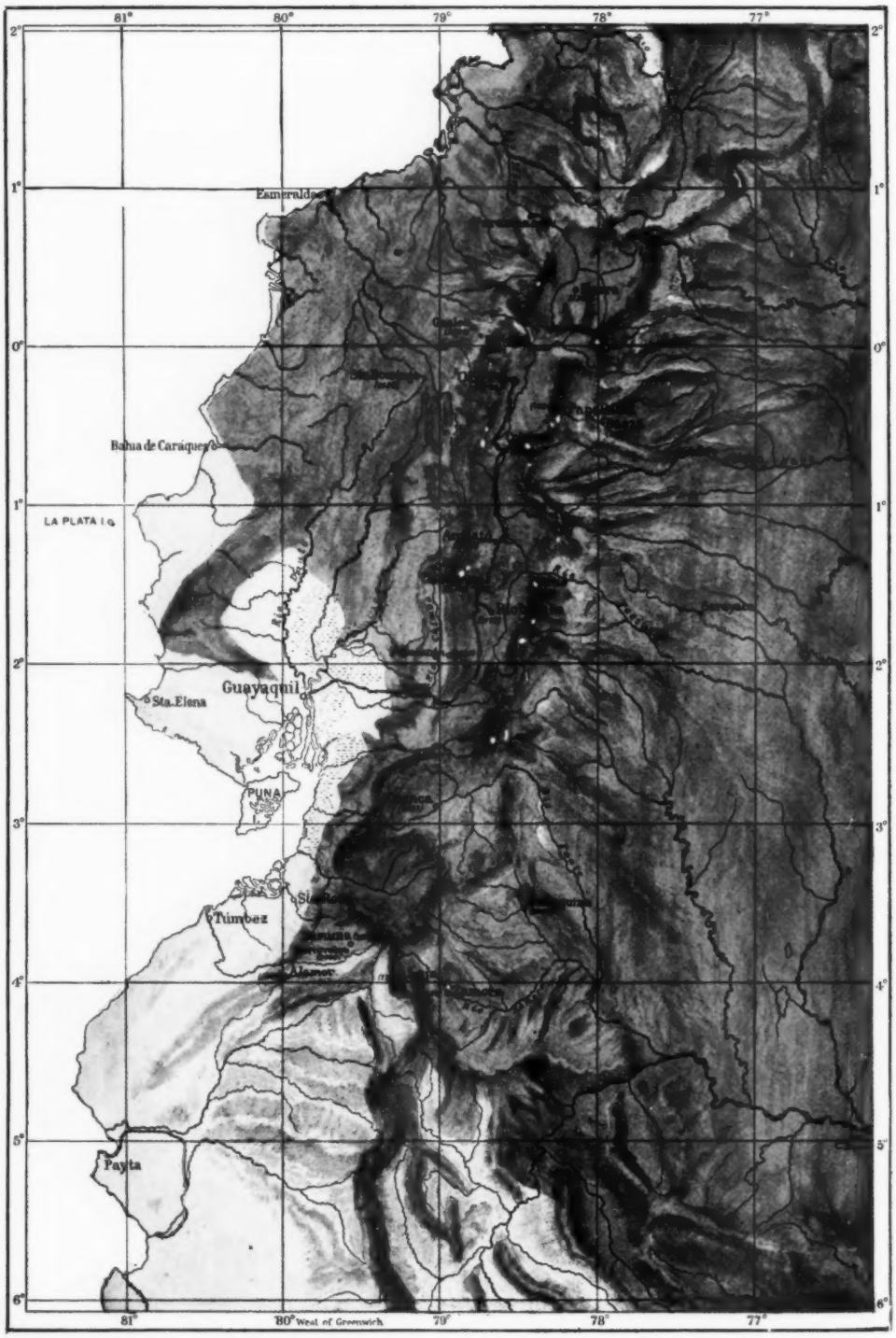

DIAGRAMMATIC REPRESENTATION OF THE LIFE ZONES OF ECUADOR AND NEIGHBORING AREAS

GREEN = Humid Tropical Zone. YELLOW = Arid Tropical Zone.
RED = Subtropical Zone. BLUE = Temperate Zone.
BROWN = Paramo Zone

"The Distribution of Bird-life in Ecuador"[1]

By WITMER STONE

Editor of *The Auk;* Director of the Museum, Academy of Natural Sciences, Philadelphia

NINE years ago Dr. Frank M. Chapman published his notable work on "The Distribution of Bird-life in Colombia," constituting the most important contribution to our knowledge of Andean birds that had appeared up to that time. Even before the completion of this work, he had planned an extension of his investigations southward into Ecuador. Some of the American Museum collectors had already begun securing the necessary material, while Doctor Chapman in May, 1916, had made a brief visit to several Ecuadorean localities. He again visited the country from July to September, 1922, to obtain first-hand information on the distribution of the characteristic birds of the several life zones, while the Museum collectors, W. B. Richardson, George K. Cherrie, Harry Watkins, Geoffrey Gill, and G. O'Connell made five expeditions into Ecuador, and the native collectors Olalla and Sons, who had been personally trained in the preparation of specimens by Doctor Chapman and his assistants, made very large collections. The result of this field work has been the acquisition by the Museum of some 13,500 specimens of Ecuadorean birds upon which Doctor Chapman has based his second report on Andean ornithology, entitled "The Distribution of Bird-life in Ecuador," which has just appeared from the press and which in every way might be termed "Volume II" of his studies of South American birds. Much that was said in our review of the former volume[2] applies with equal pertinence to the work now before us, as it follows almost exactly the same plan; and the data and conclusions are presented in the same clear and logical manner.

The great bulk of the volume (Part II.—pp. 134–702) is taken up with the distributional list of the birds of Ecuador in which are enumerated 1357 species and 151 additional subspecies, all of which, with the exception of 33, are represented in the Museum's collections. The plan of including all forms recorded from Ecuador is a distinct improvement on the Colombian report which covered only those obtained by the American Museum's expeditions.

That the bird fauna of this comparatively small country is enormously rich may readily be gathered from the above figures, but we are still further impressed when we learn that Ecuador includes within its boundaries "one fourth of the birds of all South America and one-twelfth those of the entire world"! No less than 148 species of humming-birds inhabit the country, 114 ant-birds and 160 tyrant flycatchers, 120 tanagers, 106 woodhewers, 78 manikins, 19 toucans, 39 parrots and so on down the line of bird families! No wonder that we find here an unequalled field for the study of distribution and the origin of zonal life which forms the underlying motif of Doctor Chapman's researches.

[2] "Chapman's Distribution of Bird-life in Colombia," *The Auk*, 1918, pp. 242–46.

[1] Frank M. Chapman, "The Distribution of Bird-life in Ecuador," *Bull. Amer. Mus. Nat. Hist.* Vol. LV, 1926

The "distributional list," however, is far more than a list, as references are given to the original place of publication of each species, and to previous records of its occurrence in Ecuador, while all Ecuadorean specimens in the American Museum of Natural History are listed with their localities, as well as many of those in the Rhoads collection in the Academy of Natural Sciences of Philadelphia, to which Doctor Chapman was afforded free access. There is also a brief statement of the range of each species, and of both species and subspecies in the case of geographic races.

Following this is a discussion of the relationship of each form, and its general distribution as well as its distribution in Ecuador. A well annotated list of collecting stations in Ecuador and a bibliography of the more important papers on Ecuadorean birds complete this portion of the report, which furnishes the systematist with a wealth of information, bringing together under one cover practically all of the scattered data on the birds of this astonishing country, together with the new information derived from the American Museum expeditions. In addition to its importance to the systematist this array of data has a still greater value in that it contains the facts upon which Doctor Chapman has based his discussions of the distribution of Ecuadorean bird-life and the origin of the Andean life zones which are contained in Part I of the volume.

In this part one finds, first, an extremely interesting "review" of the history of Ecuadorean ornithology, beginning with Lesson's description of four new species of birds obtained from Guayaquil in 1844 and tracing the successive explorations of William Jameson, Jules Bourcier, Louis Fraser, Rosenberg, Festa, Goodfellow and Rhoads, and the influence of Ludovic Söderstrom, long-time Swedish Consul at Quito, who for more than forty years did so much to instruct and encourage native bird collectors.

After this comes an account of the American Museum's expeditions of 1913–1925 and a detailed list of localities visited and the number of specimens obtained.

The general physiography of Ecuador is next considered. Here is pictured the great mass of the Andes rising on either side a tropical forest with an eastern and western snow-capped ridge or series of peaks from 15,000 to 20,000 feet in height, and at emperate table land between them where lies the city of Quito. The enormous differences in climate in different parts of this rugged country due to altitude and the influence that this has had in diversifying the animal and plant life are emphasized. Forest distribution is also discussed, and in this, as well as in the consideration of climate and physiography, the author adds to his original data by quoting from the works of Wolf and other writers on the physical features of Ecuador. Numerous illustrations from original photographs give one a graphic idea of the various collecting localities and the characteristic features of the several zones and habitats. Five colored plates from paintings by Fuertes picture a few of the 83 new birds described by Doctor Chapman from the Ecuador collections, while numerous maps add to the understanding of the text.

Finally, we have the "Life Zones of Ecuador and Their Bird Life" and the author's "General Summary and Conclusions," and it is to these pages in which Doctor Chapman sums up his

conclusions, that one turns with the greatest avidity.

For many years it was exclusively the systematic side of bird study that concerned ornithologists, and problems of zoögeography and of the origin of species were looked upon as somewhat outside their field of activity. Fortunately in recent years this attitude has entirely changed, and few authors are now content to publish an "annotated list" without drawing some general conclusions from the data presented. While, moreover, a "systematic list" may easily be prepared from the study of a collection in the laboratory, an author must have some personal acquaintance with the region before he is competent to attack the more general problems involved. This personal contact with Andean bird-life Doctor Chapman obtained abundantly in his explorations in Colombia, and with this foundation, his two trips to Ecuador put him in a position to grasp the problems of distribution as there presented and properly to interpret the collections and data brought to the Museum by his field assistants.

The explanation of the origin of Andean bird-life offered in his Colombian report he finds fully substantiated by his researches in Ecuador, and he is more than ever convinced of the correctness of his theory. He finds clearly defined today a Tropical Zone extending from sea level to 2000–5000 feet, a Subtropical Zone from the upper limit of the Tropical to 9000–9500, a Temperate Zone reaching up to 11,000–13,000 feet, and, finally, a Paramo Zone terminating at the snow line.

Briefly it would seem that the upheaval of the great Andean chain from the widespread tropical forest region was a gradual process or better, a succession of uplifts, which produced conditions favorable to the development of new life zones one above another. The more active species of the tropics pushed into the new areas and, as the new environment developed they developed with it into new species and new genera. So, as his tabulated data seem to prove, the bird fauna of the Subtropical (rain forest) Zone was derived from that of the tropical forest and that of the forested part of the Temperate Zone in turn from the subtropical.

When, however, the elevation became greater and the accompanying conditions of climate, etc., produced the unforested, or arid regions, of the Temperate and Paramo zones, these areas, being in direct touch on the south with sea-level regions of exactly the same physiographic character, were at once populated by south temperate species which spread, more or less rapidly, northward.

So we have these two sources of Andean bird-life, one, the spreading of an existing south temperate fauna northward through similar contiguous areas and, the other, the development of an entirely new fauna from one lying directly below it. The fact that the tropical and subtropical faunas are so distinct today and that the subtropical forms have left no "intergrades"—no clear traces of their development from their tropical ancestors—is probably due to the gradual nature of the evolution of both environment and species for, as Doctor Chapman says, "zone and fauna were developed together." The Subtropical Zone did not exist prior to the Andean upheaval and, when it occupied the tops of the mountains, there was no contiguous area of similar character with a fauna ready to spread into it, as in the case of the arid Temperate and Paramo zones, and it

had to develop a fauna step by step with its own development from the tropical forest below.

Probably all students of zoögeography had their attention turned to this subject by the classic volumes of Wallace, and, like the writer, have never forgotten the fascination of tracing the history of the earth's changes from the present distribution of life. And so the problems discussed by Doctor Chapman hold our attention and arouse our enthusiasm, as step by step we seem to see the development of the wonderful avifaunæ that populate the successive altitudinal zones of the great Andean Chain, which he so graphically describes.

While it is impossible, in the short space at our disposal, to consider all the interesting zoögeographic problems that he presents, or to quote the array of tables and distributional maps with which he fortifies his theories, we may, however, mention one of them involving the origin and extent of the west Ecuadorean tropical fauna, which is now so completely separated from the great Amazonian tropics by the whole chain of the Andes, although the identity of many of the birds in the two areas shows that they were once contiguous.

An abundance of data from various sources shows conclusively that the condition of aridity or of forest growth along a seacoast is dependent upon the relative temperature of land and water. Where the water is warmer than the land, and the air over it is blown to the shore, its temperature is lowered and precipitation follows with resultant heavy rains and luxuriant forest growth; but when the conditions are reversed the opposite is the case and we have a minimum of rainfall and a desert environment.

The former is the normal condition and prevails along the Pacific coast of South America from Colombia to northwest Ecuador, and on the coast of southern Chile; from the latter region to northwest Peru, however, the cold Humboldt Current washes the shores, and we have in consequence a continuous arid coastal region. From Cape Blanco the main Humboldt Current sweeps westward to the Galapagos, which are consequently desert, but a narrow arm continues north, producing a semi-arid fauna on the Ecuador seacoast, populated by birds of Peruvian desert origin, while inside of this at the base of the mountains is a strip of the humid tropical forest of western Colombia and northwestern Ecuador. It seems probable, moreover, that western Ecuador was more extensively desert before the Andean upheaval and from the fact that there are many more Amazonian tropical birds in northwest Ecuador than farther to the south, it looks as if this west Ecuadorean tropical fauna had been populated from the east, probably though passes in the Colombian Andes which were open to passage of tropical species long after the greater upheaval in Ecuador had effectually separated the two regions.

The point to be borne in mind in these interesting discussions is that the theories are all based upon definite figures and facts deducted from the study of the bird-life of this rugged country.

Fascinating as are his zoögeographic discussions, to our mind the most important feature of Doctor Chapman's work is the mass of evidence that he presents to show that "first as well as last, evolution is largely the product of environment, particularly of change of environment, with more or less direct

A NEW HUMMINGBIRD FROM ECUADOR

The Aethereal Sylph (*Cyanolesbia cœlestis æthereus* Chapman)

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NEW BIRDS FROM ECUADOR

1.—Zaruma Ant-Bird (*Grallaricula costaricensis zarumæ* Chapman)
2.—White-faced Ant-Bird (*Aptocryptornis lineifrons* Chapman)
3.—Watkins' Ant-Bird (*Grallaria watkinsi* Chapman)

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NEW BIRDS FROM COLOMBIA AND ECUADOR

1.—Red-tail Pacific Paroquet (*Pyrrhura melanura pacifica* Chapman)
2.—White-breasted Paroquet (*Pyrrhura albipectus* Chapman)

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action on the organism and its rejection or retention of the resulting characters." It seems most significant that when ornithologists with their wide field experience and knowledge of environment and their extensive series of specimens come to consider the origin of a species or subspecies, they never for a moment question the dominant part that environment plays in the matter, and always agree with Doctor Chapman that "physiological agencies which give rise to variations are enormously stimulated by the action of environmental forces, and that nothing is more effective in promoting evolution than to subject an organism to a new set of environmental influences."

This all seems so clear that with Doctor Chapman we are amazed at the claims of the geneticists "that chance mutation is quite sufficient to account for all organic evolution!" Such claims, unfortunately, are usually made by those who have never studied species and subspecies in nature, where to our mind they must be studied, and are not trained to interpret the evidence presented by adequate series of specimens combined with data on the environment in which they were obtained, but the present attitude of a few geneticists, such as Dr. F. B. Sumner, is most encouraging and must result, we think, in a more general modification of views.

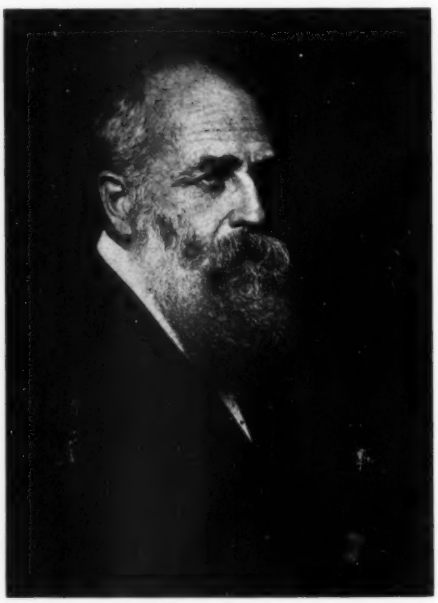
Ornithologists have been too reticent in the matter of taking part in these broader inquiries, and we feel that the forcible emphasis that Doctor Chapman has given to his views on the problem of the origin of species through environmental influence really constitutes the most important feature of his work. He has, in fact, given us three things in one: a masterly systematic treatment of the bird fauna of Ecuador; a fascinating discussion of the origin of the Andean life zones and the present faunal areas of South America; and a forceful plea for the proper recognition of environment in the evolution of species.

When results such as Doctor Chapman has produced can be obtained, the time devoted to the field work is time well employed, the acquisition of the large collections is well worth while, and the money spent in this kind of research is money well spent. The American Museum is to be congratulated upon an important piece of research well done, and the author upon another notable contribution to ornithology in its broadest sense.

Felix von Luschan and His Collections

By CLARK WISSLER
Curator in Chief, Division of Anthropology, American Museum

SOME time ago the American Museum acquired the famous anatomical collection and the library of Prof. Felix von Luschan. Since death has now brought Professor von Luschan's work to an end and as this collection represents in many respects his greatest contribution to anthropology, it is fitting that something be written about the man and the personality expressing itself in this collection.



Professor Felix von Luschan
1854–1924

It is generally true that a great museum collection is the life work of some one individual, who expresses in the collection his zeal, his spirit of inquiry, and who impresses them also upon all who meet him. It is also believed that the biological sciences as they stand today owe a great deal to the natural history cabinet of a century ago and to the enthusiastic collector. In any event, the collection of scientific materials in the past dignified the sport of exploration, so that now a person who goes out to roam in the unfrequented parts of the earth cannot claim the title of explorer, or escape contempt, unless he gives intelligent attention to scientific materials or makes scientific observations.

But while the passion to explore and to collect is probably inherent, it is but rarely that we meet with a genius. Such was Professor Von Luschan. We know little of his early life except that he was the son of a court barrister and was born August 2, 1854, in Oberhollabrunn, a village near Vienna. We are told that he attended the high school in Vienna and about his seventeenth year took up the study of medicine in the University of Vienna. Here he labored for seven years, graduating with honors, and receiving the degree of doctor of medicine in 1878. Throughout all this period of routine education, we learn that the collecting spirit was strong. Even before entering high school, he was collecting natural-history specimens and, following the usual human interest, became an antiquarian. No one seems to know just why all of us are so moved by what is old and by what belonged to the ancients, and why we stand ready to turn archæologist on the least provocation, but that is one of the hidden springs within us. It is not strange, then, that young Von Luschan, with his scientific bent, should feel the call of the

antiquarian, and that we should find him at eighteen years of age carrying on archæological excavations in Austria.

However, his medical studies were destined to turn his collecting interests to human anatomy and, after receiving his medical degree, he seems to have made a concession to his antiquarian interests, a kind of compromise between medical anatomy and anthropology, since he went to Paris for a time to study with Paul Broca, one of the founders of racial anthropology. If he had not previously committed himself to collecting the racial types of the world, he did now, for we learn that he spent all his savings and what he could spare by cutting his living expenses to the bone, in order that he might purchase skulls brought back to Paris by travelers and traders. The studies of Broca and his predecessors had stimulated a market for such specimens and the genius of Broca impressed upon the young Von Luschan the value and scientific importance of such material.

After a brief stay in Paris, Von Luschan returned to Austria and served in the army for a year as a medical officer. He was stationed in Bosnia, at that time in the military control of Austria, now a part of Jugoslavia and previously under the control of Turkey. This sojourn in interesting archæological territory greatly stimulated him and added to his passion for collecting scientific material.

Following his brief military experience, Von Luschan spent two years in hospital work in Vienna. During all this time by great sacrifice, he continued his collection of skulls and other racial material, and indulged in every possible way his passion for archæological research. Thus we learn that in 1880, he made a collecting trip to Dalmatia and Montenegro, for the Royal Museum of Natural History in Vienna, and in 1881 and again in 1882, made similar trips to Asia Minor. As a logical result, therefore, he was admitted in 1882, to the medical faculty of the University in Vienna, to teach anatomy and anthropology.

After this Professor Von Luschan spent a part of almost every year in field collecting, chiefly in the Near East, making systematic excavations in northern Syria from 1889–1902. Here he acquired the famous archæological collections now in the Museum at Berlin and incidentally added greatly to his growing anatomical collection now in our Museum. In 1888 he joined the staff of the Ethnographical Museum in Berlin, and it was under the auspices of this institution that his subsequent expeditions were made. Later, he was professor of anthropology in the University of Berlin, where his anthropological laboratory became famous and where a number of American students received their training. Over and above all, Professor Von Luschan was a teacher, and the one great drive back of his collecting was to accumulate materials for use in imparting knowledge and enthusiasm to his students. Yet it is apparent that he was also an explorer and a museum enthusiast, thus combining all the essential high qualities necessary to a real naturalist.

J. L. Wortman—A Biographical Sketch

By HENRY FAIRFIELD OSBORN
Honorary Curator

THOSE who have never been in a fossil-hunting camp with J. L. Wortman and witnessed his boundless energy and enthusiasm can hardly realize the great part he played in the history of vertebrate palæontology in America. It was indeed a rare bit of one's education as a palæontologist to see him return to camp on a cold night after a hard day's fossil-hunt, roll a cigarette, huddle as close to the fire as possible, and tell glowingly of the day's discovery or lament bitterly the fatigue and exhaustion of fruitless search. After a large draught of hot coffee and perhaps a good supper, the casualties of the day were forgotten and the Doctor would begin to philosophize or discuss some favorite hobby of his in comparative anatomy or to expound some new theory of mammalian descent, stimulated perhaps by some outstanding "find" of the season. Such personal contacts were frequently enjoyed by the writer of this tribute during the brief but brilliant period of eight years when Doctor Wortman laid the first field foundations of mammalian and reptilian palæontology in the American Museum of Natural History.

J. L. Wortman, first field collector of the department of vertebrate palæontology, American Museum

The writer's first choice of a field leader fell in the autumn of 1890 upon John Bell Hatcher, who was at that time in the Peabody Museum of Yale University under Professor O. C. Marsh. Hatcher had, indeed, made the first advances to the American Museum of Natural History, but after arranging for a definite call he was induced to retain his old post under Marsh, wherein he had done signal service in the collection of the titanotheres of South Dakota and the giant horned ceratopsians of Converse County, Wyoming. Upon Hatcher's final declination, Wortman received the call from the American Museum. He was already highly experienced—in fact, a peer of Hatcher's, for he had served for an equally long period under Marsh's great rival, Cope,

especially in the Lower Eocene formations of the Wind River and Wasatch of Wyoming.

Accordingly, when the summer of 1891 was well advanced, Wortman, as assistant curator of the department of mammalian palæontology, went into the Wasatch beds of Wyoming and, despite his previous explorations there, brought back a small but very important collection of *Coryphodon, Eohippus, Systemodon, Heptodon*—in other words, coryphodonts, four-toed horses, tapirs, and lophiodonts. In a very small laboratory in the very roof of the Museum, at the top of an old elevator shaft, Wortman and the writer worked these fossils out of the rock together, and extracted from them much new and significant light upon the life and times known as 'Wasatch' and the 'Wind River.' The outstanding discovery was the beautiful skull of *Palæonictis*, a very ancient carnivore, hitherto known only in the Soissonais of France. Many of the new points of great interest were described in the first joint bulletin of Doctor Wortman and the writer, which was published in 1892 under the title of "Fossil Mammals of the Wasatch and Wind River Beds."

With this very promising opening of the year 1891, Doctor Wortman continued as leader of all the American Museum expeditions to the Rocky Mountain region between the years 1891 and 1898, and it was with great regret in the year 1899 that the Museum accepted his resignation as assistant curator to become curator in charge of vertebrate palæontology in the Carnegie Museum of Pittsburgh.

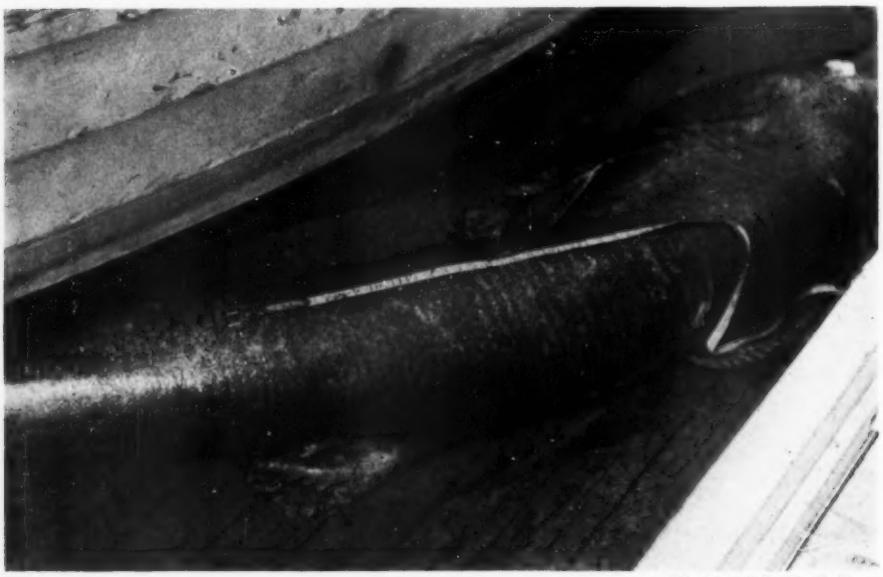
Meanwhile, he had not only very thoroughly explored the Wasatch, Wind River, and White River horizons of Dakota with new and brilliant results in each field of work, but had begun, in the final season of 1899, to explore the dinosaur beds of Wyoming in the region of Medicine Bow, the locality famous in literature as the starting point of *The Virginian* of Owen Wister. Not the least of his great services to palæontology and to the American Museum during this period was the splendid field training which he gave to Walter Granger, Albert Thomson, and O. A. Peterson, each of whom has since become distinguished in the branch of work in which he served as apprentice under Wortman.

His chief contribution to science previous to this period was a book on the anatomy of the teeth. While serving under Professor Cope, Wortman had no opportunity to describe any of the remarkable fossils which he discovered. As soon as he came under the writer's direction, he was given a generous share of the fossils of his own finding and in several instances the best finds of the season were placed in his hands, notably the very ancient animals he called *Ganodonta*, which are otherwise related to the sloth tribe but are distinguished by the persistence of enamel on the teeth, a dental feature which is wanting in all the true Edentata. His contributions to the *American Museum Bulletin* between the years 1892 and 1899 include fourteen papers numbering 394 pages.

After his many years of service in the American, the Carnegie, and the Yale museums, Doctor Wortman retired to Brownsville, Texas, where he lived until his decease, on June 25, 1926.

Photograph by George Palmer Putnam

A Greenland shark (*Somniosus microcephalus*) caught by natives at Upernivik, North Greenland, and being hauled aboard the launch by Carl Dunrad and Will Bartlett. These sharks which appear so firm and whiplike under water are really quite soft, and partly flabby, when taken out of their element. In years past these great carrion eaters accompanied the whalers about Greenland and even off the northeastern coast of the United States, appearing in numbers when there was flesh to be had



Photograph by H. C. Raven

A search of the literature dealing with fishes of the north Atlantic has failed to reveal a record of the color pattern of the Greenland shark, which consists of numerous dark bands on the back and sides of its body. Part of the animal's dark grayish-brown color is due to dirt and slime adhering to the rough skin, but the color pattern remains after this has been washed off

The Greenland Shark

By H. C. RAVEN
Associate Curator, Comparative and Human Anatomy

ONE of the most important specimens secured by the American Museum's Greenland Expedition under the leadership of Mr. George Palmer Putnam was the Greenland shark, which will be prepared for exhibition in the new Hall of Fishes. This animal inhabits principally the seas about Iceland and Greenland, and rarely comes far enough south to be taken on the northeastern coast of the United States. In consequence of its boreal habitat, few naturalists have had the opportunity of observing this interesting animal in life.

The body of the Greenland shark is slender and nearly circular in section, gradually tapering backward from the region of the pectoral fin, where it is thickest. This shark is characterized by small fins, the dorsals, about equal in size, being exceptionally small and spineless, though as in members of the Squalidæ to which it is related there is no anal fin. The tail resembles the homocercal type in outline, though less so than in the mackerel sharks. All the fins are comparatively thin and more flexible than in most sharks, which gives an impression of weakness.

The skin is decidedly rough and abrasive, as it is covered with erect shagreen denticles. The color of the animal as a whole is dark grayish-brown. Part of this coloration is due to slime and dirt adhering to the skin, even in life. When this has been scraped off, the skin is seen to be more of a bluish-gray, without any brown. The back and sides of the body are crossed by numerous narrow dark bands which, as a rule, are not very distinct.

By examination of five specimens, the food of these fishes was shown to be practically any kind of flesh they were able to obtain. Most often there would be remains of small fishes, the two commonest species being the Greenland rock cod (*Gadus ogac*) and the Greenland sculpin (*Myoxocephalus scorpius*). One shark contained the remains of a small lump-fish only five or six inches in length. In another was the greater part of a small seal (probably *Phoca vitulina*) which had been bitten to pieces, each piece being from seven to ten inches long. There were feathers of some sea bird and numerous invertebrates and other material that was unidentifiable.

The Greenlanders catch these sluggish sharks on ordinary hook and line and use the dried flesh for food for dogs during the winter. The most valuable part of the shark, however, is the liver, from which a quantity of oil is procured by boiling. This oil is placed in kegs and shipped to Denmark The liver is large,—that of a ten-foot shark measured six feet.

The largest shark we saw was slightly more than ten feet long. The average length is about nine feet and the maximum of which I have heard was approximately fifteen feet.

NOTES

CENTRAL ASIATIC EXPEDITIONS

WINTER PLANS.—Mr. Walter Granger, chief palæontologist of the Museum's Central Asiatic Expeditions, in a letter addressed to President Osborn dated October 15, 1926, from Yunnanfu, outlines plans for the winter. With Mr. Granger is Mr. N. C. Nelson, archæologist, who is searching for remains of prehistoric man. As far as Yunnanfu the two explorers were accompanied by their wives. The party arrived there on September 17 after having had experiences with typhoons on the China coast and delays at Tongking due to the flooding of the country, which interfered with railroad travel. By good fortune the trip to Yunnanfu, a three days' ride, was made without delay between long periods of interrupted railroad traffic.

Nearly a month was required at Yunnanfu to secure a caravan of thirteen horses and attend to formal and official matters. On the day of writing the caravan had gone forward to a temple on the opposite side of the lake, where camp would be made for the night. Mr. Granger and Mr. Nelson were to make this part of the trip by boat. Mrs. Granger and Mrs. Nelson were to remain at Yunnanfu, where they were to keep house in the American

Consulate during the interval following the leaving of Mr. Myers, the consul, and the arrival of his successor.

The plan of operations is first to make a six or seven days' trip to Yuan-Kiang on the Red River, almost directly south of Yunnanfu, dropping from an altitude of 6500 feet to one of 1500 feet. It is hoped that Mr. Nelson may find archæological remains in the Red River valley and that Mr. Granger may make a zoölogical collection. Later a trip westward from Yunnanfu to Talifu is planned, to be followed by trips to the northwest and east. Besides these definite trips, Mr. Granger hopes to visit certain localities from which fossils have been obtained. Conditions, however, are bad as regards bandits, and travel, even by missionaries, is now restricted in Yunnan.

FISHES

ANGOLA FRESH-WATER FISHES.—The department of fishes is studying a fresh-water collection obtained in Angola by the Vernay Expedition. This area lies just outside the remarkable highly developed fish fauna of the Congo Basin, and this collection comprises mostly minnows (*Barbus*) and perchlike Cichlids, with only an occasional Mormyrid and Characin. A review of Angola fishes correlated with Mr. Boulton's (one of the collectors) more or less first hand knowledge of the physiography of the country, should give an interesting side light on the distribution of old-world fresh-water fishes. The genus *Barbus* seems to have entered Africa in the northeast, spread rapidly through east and multiplied in south Africa, without gaining any dominant position in the Congo fauna.

MAMMALS

MEDITERRANEAN SEALS FOR THE MUSEUM.—Through the field work of Mr. Jesse Metcalf, of New York City, the American Museum has just acquired skins and entire skeletons of three Mediterranean seals, comprising an old male 8 feet 6 inches long, an adult female, and a very young cub. The specimens are accompanied by measurements, as well as by photographs and notes relating to the animals and to their haunts among the sea caves of the Desertas Islands, off Madeira.

This rare seal which was formerly widely distributed in the Mediterranean region, is one of the subtropical genus known as *Monachus*, the "monk seals." Seals of related species were formerly abundant in the Caribbean Sea and on the shores of certain mid-Pacific islands, but they have long been greatly reduced in numbers, if not quite exterminated. It is believed that the three examples of the Mediterranean species which Mr. Metcalf has presented, are the first in any American collection.

The search for this seal was one of the objects of the cruise described in the leading article of this issue of NATURAL HISTORY. It was not encountered within the Mediterranean Sea, however, although Mr. W. K. Vanderbilt reports that he recently observed one or more of the animals off the coast of Tunis.

After Doctor Murphy's departure from the "Wawaloam," Mr. Metcalf continued his voyage, taking with him Mr. Ogilvie Gordon, of London, as natural history collector. The yacht first visited the Spanish island of Alboran and then proceeded through the Strait of Gibraltar and southward to Madeira, the Desertas and the Salvages groups. Landings were made and collections obtained upon seven or more islets, the most interesting experiences being the penetration of the seal caves on Deserta Grande and the subsequent capture, with the aid of several skilled Portuguese cragsmen, of a family of the desired sea mammals. Throughout the work at the islands, the expedition received generous privileges and personal assistance from Col. A. R. B. Cossart, of Funchal, owner of the Desertas.

Other natural history material obtained by Mr. Metcalf in this part of the world includes insects, marine fishes, and invertebrates, lizards, and both land and sea birds. Among the birds are several kinds new to the collections of the Museum. Most interesting of all is a petrel (*Pterodroma mollis feæ*) locally called by the Portuguese word meaning "nun." It is known to nest in only a few inaccessable localities on the islands between Madeira and the Cape Verde group. Specimens of adults and young make an important addition to the Museum's collection of petrels and their allies, which is now more nearly complete than any other in the world.

One downy chick of the "nun petrel," obtained on the Island of Bugio on September 23d, has been fed on raw fish by Mr. and Mrs. Metcalf, and on the date of this note (December 31) is still flourishing in New York. There is perhaps no other instance of a bird of this group thriving so long in captivity.

TAYLOR SUDAN EXPEDITION.—Mr. Irving K. Taylor, a Life Member of the American Museum of Natural History, one of the Board of Directors of the New York Zoological Society, and a director of the Explorers Club, left New York City early in December on an expedition to the Egyptian Sudan. Mr. Taylor has made three expeditions into this region as a sportsman and has generously decided to make his fourth trip to the Sudan an American Museum expedition. He is taking with him as the Museum representative Mr. H. E. Anthony, curator of mammals of the world in the American Museum.

This expedition is known as the Taylor Sudan Expedition and all of the resources and energies of the party will be devoted to the collection of material for the Museum. The primary purpose is the formation of large study collections of mammals, birds, fishes, and reptiles, together with photographs, both moving and still, and notes on observations, etc. If any fine exhibition material is secured, plans will be made to include it in the proposed Hall of Mammals of the World.

Mr. Taylor's long experience in the region insures an advantageous arrangement of transportation. Part of the time the expedition will work from a small steamer, chartered specially for the trip, ascending the White Nile and stopping to collect wherever specimens are encountered. There will also be one or more trips made by camel away from the Nile to collect the desert fauna and the animal life of the foothills along the Abyssinian frontier.

The region about the White Nile and the Blue Nile is today one of the finest hunting grounds in Africa. Not only are most of the commoner species of African mammals encountered here, but also species of antelope, such as the white-eared kob and Mrs. Gray's kob, which are found nowhere else. The American Museum has practically no material from the Sudan in its collections, and Mr. Taylor's generous gift of all of the specimens to be collected on his expedition will fill a very real need.

The Taylor Sudan Expedition will be gone about six months and will operate out of Khartoum as a base.

MINERALS

A NOVEL IDEA IN LOCALITY COLLECTIONS.—During the recent visit to this country of Queen Marie of Roumania, the department of minerals in the American Museum featured a temporary exhibit of the minerals of Roumania, involving several ideas that are believed to be new in museum installation.

The 250 specimens representing Roumanian localities contained in the general series were not removed to a separate case, but remained in their places distributed throughout the collection, and were designated by a narrow strip of colored paper in the Roumanian colors (red, orange, and blue) attached to the mount. Paper shields 1½ inches by 1¼ inches in the same colors were attached to the glass of the cases as markers in such a manner as not to interfere in any way with the view. A group label of conspicuous size and position called the attention of the visitor to the specimens thus singled out, by directing him to look for the Roumanian colors.

This method of installation for temporary locality series has an educational advantage over the older and more universal method of segregated specimens, because it admits of the specimens being compared with those from other localities, and also in the ease with which it shows what proportion of a certain species or group comes from the selected locality.

SCIENCE OF MAN

DR. J. R. WALKER, for many years a physician in the United States Indian Service, died at his home in Denver, December 13, 1926. He was a careful student of Indian life, specializing on the Sioux Indians of Dakota. Part of the Dakota collection in our Plains Indian Exhibit was received from him and a detailed study of the religious beliefs of these Indians, entitled, "The Sun Dance and Other Ceremonies of the Oglala Division of the Teton Dakota," was published by the Museum. He carried on investigations of a physiological and medical nature among the Indians in his charge, the results of which were published elsewhere. He was an enthusiastic supporter of the Museum, and was endowed with a lovable personality which endeared him to all.

THE SEASON'S ARCHÆOLOGICAL EXPLORATION IN ARIZONA under the Ogden Mills Survey has just been completed. Following up the work of last year in Cañon del Muerto, this season operations were extended into the adjoining cañon, de Chelly, where rich deposits of Cliff Dweller refuse were excavated. These deposits were near the famous White

House cliff ruin, shown in the background of the great Navajo group in our hall for the Southwestern Indians. The part of the cañon adjoining this ruin is of special interest since the ruin itself occupies a grotto some fifty feet above the valley floor, with a second ruin at the foot of the cliff directly beneath the grotto. The two together constitute the most spectacular aboriginal monument in the entire de Chelly cañon system, of which Cañon del Muerto is a part. The only possible rival to the White House and its setting is Mummy Cave in Cañon del Muerto in which extensive excavations were carried on last season. Mr. Earl H. Morris was in charge of the work, assisted by Mr. Erich F. Schmidt of the Museum staff. No excavations in the upper ruin were undertaken, attention being given wholly to the lower one and to the large heap of refuse on the valley floor and containing, for the most part, pottery and other objects thrown down from the dwelling above. The rooms of the lower ruin were cleared. Sections of this refuse deposit were excavated, revealing successively from the bottom upward, the following culture periods in the prehistory of the Southwest: Post Basket Maker, Pre-Pueblo, and Pueblo. Several small burial plots were found yielding an unusual store of pottery vessels, one grave containing nineteen vessels in all. The collections resulting from these excavations are rich in woven objects, particularly sandals. In addition there are many examples of cotton cloth, cord, matting, etc. It so happened that the refuse deposit was protected by the overhang of the cañon wall and thus kept dry, preserving all objects of fiber, wood, and other perishable materials. Consequently, this collection gives a much better picture of prehistoric life in the Southwest than do ordinary archæological collections.

ANCIENT SALT MINE IN ARIZONA.—In August of this year Mr. Warren S. Smith, representing the Western Chemical Company informed the Museum that an ancient salt mine had been discovered at Camp Verde, Arizona. This information was forwarded to Mr. Earl H. Morris, then on his way to Cañon del Muerto. Mr. Morris made a brief visit to Camp Verde, where every courtesy was extended him by the local officials of the Western Chemical Company. His observations revealed that in prehistoric times the Indians of that vicinity had mined for salt in the deposits at that place, running tunnels underground many feet. In some of these tunnels were evidences of prehistoric mining operations, consisting of bark torches, worn-out sandals, mats, and carrying devices, together with mining tools of stone. In order to date these salt mine operations archæologically, Mr. Morris explored several near-by cavelike dwellings, from which he secured a collection of cotton cloth, matting, sandals, and implements similar to those found in the tunnels. From these materials it may be possible to fix the time of these mining operations. One unique find was an infant burial, the body rolled in many pieces of cotton cloth, one of which bore an elaborate embroidered design of unusual excellence.

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THE MUSEUM IN FIELD AND STUDY

JANUARY-FEBRUARY

The first number of NATURAL HISTORY for 1927 brings up to date many of the activities of the American Museum both in the field and in the study.

The quest for the semi-mythical dragon lizards of Komodo led the Burden East Indian Expedition halfway around the globe to the Dutch East Indies. Mr. Burden tells how he found and captured these giant lizards,—living remnants of the monster saurians which lived in Australia during the Pleistocene Age.

As the ice of the last glaciation melted and disappeared from eastern North America, it left behind annual records of its retreat in the stratified clay sediments deposited by the rivers that flowed out from under the ice mass. Dr. Chester A. Reeds tells how, in assembling the American Museum's series of sections of these clays from near New York City, he is unfolding a new chapter in the palæogeography of the region.

While most of us picture Greenland as eternally buried under snow and ice, in reality part of the coast is free during the summer months. Mr. H. C. Raven, of the American Museum Greenland Expedition, saw flowering plants, birds, polar bears, walrus, and seals, and describes the fine series of narwhal (fabled unicorn of the ancients) secured by the Expedition, from which models will be made for the Hall of Ocean Life.

Samos, ancient scene of the journeys of St. Paul and St. John, was visited by Barnum Brown in his recent fossil-hunting expedition. The romantic background of the region, together with the geological relationship of the fossils, found only on a single narrow strip on the island, form the theme of Mr. Brown's story for the next number of NATURAL HISTORY.

Dr. G. Kingsley Noble discusses the rôle of environment and heredity in an animal's inheritance, with special reference to experiments which he has been carrying on in the Museum's laboratories.

That many species of fishes exercise parental guardianship over their egg nests up to the time the young are hatched, is an interesting phenomenon of fish life. Dr. E. W. Gudger describes the only known gunnel "nest" on exhibition in any museum, which is presently to be installed in the new Hall of Fishes.

Prof. T. D. A. Cockerell's article on his recent trip to South America for fossil insects relates the incidents of "a journey packed with varied experiences, worth while equally for scientific results, knowledge of the physical conditions, and the delightful contact with interesting people."

The museums of France, Spain, and Italy were visited by Mr. H. P. Whitlock during last summer, with special reference to studying arrangement and presentation of exhibits. He gives his impressions in "A Museum Pilgrimage."

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The **SCHOOL SERVICE** of the Museum reaches annually about 6,000,000 boys and girls through the opportunities it affords classes of students to visit the Museum; through lectures on natural history especially designed for pupils and delivered both in the Museum and in many school centers; through its loan collections, or "traveling museums," which during the past year circulated among 410 schools, and were studied by 977,384 pupils. During the same period 672,479 lantern slides were loaned by the Museum for use in the schools, the total number of children reached being 3,941,494. 1,076 reels of motion pictures were loaned to 48 public schools and other educational institutions in Greater New York, reaching 333,097 children.

The **LECTURE COURSES,** some exclusively for members and their children, others for the schools, colleges, and the general public, are delivered both in the Museum and at outside educational institutions.

The **LIBRARY,** comprising 100,000 volumes, is at the service of scientific workers and others interested in natural history, and an attractive reading room is provided for their accommodation.

The **POPULAR PUBLICATIONS** of the Museum, in addition to NATURAL HISTORY, include *Handbooks*, which deal with the subjects illustrated by the collections, and *Guide Leaflets*, which describe some exhibit or series of exhibits of special interest or importance, or the contents of some hall or some branch of Museum activity.

The **SCIENTIFIC PUBLICATIONS** of the Museum, based upon its explorations and the study of its collections, comprise the *Memoirs*, of quarto size, devoted to monographs requiring large or fine illustrations and exhaustive treatment; the *Bulletin*, issued since 1881, in octavo form, dealing with the scientific activities of the departments, aside from anthropology; the *Anthropological Papers*, recording the work of the staff of the department of anthropology; and *Novitates*, devoted to the publication of preliminary scientific announcements, descriptions of new forms, and similar matters.

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